



Happy New Year!

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Volume 28, Number 1

January/February 2005

Additional P3E Progress



Andreas Werner with the early construction of P3E that is to be used for the completion of the cable assembly and later as a demonstration model. See article on page 31.

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AMSAT-UK Colloquium 2005 Call for Papers

This is the first call for speakers for the 20th AMSAT-UK Colloquium, which will be held at Surrey University, Guildford, Surrey, U.K., from Friday 29 July to Sunday 31 July 2005.

AMSAT-UK invites speakers, about Amateur Radio space and associated activities, for this event. Authors/speakers are also invited to submit papers for the "Proceedings" document, which will be published at the same time but printed papers are not mandatory. We normally prefer authors to present talks themselves rather than having someone else give them in the authors' absence. We also welcome "unpresented" papers for the Proceedings document.

Offers of talks should be submitted as soon as possible; the final date for full documents to be received is mid-June 2004 so that the "Proceedings" document will be available to participants.

Submissions should be sent ONLY to G3WGM, via the following routes:

Internet e-mail: g3wgm@amsat.org

Terrestrial mail: J.D. Heck, Hon Sec, AMSAT-UK, Badgers, Letton Close, Blandford, Dorset DT11 7SS United Kingdom

FAX +44 (0) 870 0631551

AMSAT-UK also invites anyone with requests for program topics to submit them as soon as possible to G3WGM. Invitations for any papers on specific subjects will be included in the future call. Likewise, if anyone knows of a good speaker, please send contact and other information to G3WGM.

Additionally, AMSAT-UK will be running sessions specifically for beginners to amateur satellite operating on Friday and Saturday afternoons. Volunteers are wanted to speak at these sessions.

73,
Jim, G3WGM
Hon Sec AMSAT-UK ☎

AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





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The AMSAT Journal staff is always interested in article submissions. Whenever possible, submissions should be sent via e-mail to journal@amsat.org using plain text or word processor files; photos or figures in TIF, GIF or JPEG formats. AMSAT-NA reserves the right to select material for *The AMSAT Journal* based on suitability of content and space considerations. The editors of this publication are volunteers giving freely of their talents, time and efforts to produce *The AMSAT Journal*.

APOGEE VIEW

by Rick Hambly, W2GPS • w2gps@amsat.org

I can't believe that two months have already gone by since the last time I sat down to write an Apogee View column.

It seems like yesterday. It must be due to all the activities that surround the holiday season, including the birth of a grandchild on December 21st followed the next day by a trip to the mountains west of Denver, Colorado to visit two more grandchildren. By the time I got my feet back on the ground at home I was three weeks behind on e-mail and had a significant backlog of AMSAT and commercial business actions items. January will be the month I get caught up, I hope.

In the last Apogee View column I introduced you to the Strategic and Tactical Planning initiatives that have been the focus of AMSAT's Board and Executive Team members in recent months. This time I would like to provide some details about what the AMSAT teams are doing.

Strategic Planning

At the conclusion of the February 2004 Strategic Planning meeting we had agreed on Mission and Vision statements for AMSAT. We want to describe what these really mean in a new Strategic Plan document but that must wait until we resolve a set of issues that resulted from this meeting. The issues are listed here essentially as they were at the end of the Strategic Planning meeting a year ago.

Priority A:

- Define Roles and Expectations for BOD and Officer positions.
- Lessons Learned from Previous Satellite Projects.
- How many will care?
- How do we get to those who do?
- How will we 'make' money?
- How are you unique and how will we defend our space?
- How do we put together the team to pull it off?
- How much money do you need and where does it take you?

Priority B:

- Define the high earth orbit plan including a low cost ground station.
- Define the LEO plan.
- Define the Human Spaceflight Plan.
- Define the Communications Plan.
- Define the Partnership Plan.

Priority C:

- Define a training plan for working with volunteers.



The board members have been meeting in teleconferences every two weeks since February to work on these action items. In 2005 this will be scaled back to one a month to make room for a new Tactical Planning teleconference. This process has kept your leadership teams actively engaged throughout the year in planning for AMSAT's future and has begun to achieve significant improvements to AMSAT, both internally and to our external image.

Tactical Planning

AMSAT's Executive Team implements the Board's strategic planning directives. Members of the team are the leaders of the various tactical teams, each with a specific focus area. Starting in 2005 the Executive Team meets in a teleconference once a month to exchange status reports and to solicit assistance from each other.

For example, the AMSAT office is upgrading its Internet connectivity and has obtained a new laser printer to help deal with the large number of orders being generated by the new Web site store. That's a problem we are glad to have.

The Treasurer, W8GSM, working with a sub-committee from across various teams, is working to define the requirements for an improved management information system, focusing on a modernized membership database. This is needed to answer important questions that arise during external fund raising efforts, generate letters and reports and to lay the groundwork for member services on our Web site.

Our Executive VP, KU4OS, is planning for an AMSAT presence at a number of industry, government and educational conferences for 2005. These are the places where we need to remind people that we are here looking for launch opportunities and evolving a new educational outreach program. The contacts we make at these meetings may well form the basis for our next launch or another satellite project with some college or university.

Our Operations VP, KE4AZN, has been busy managing AO-51 to best serve our community. For a time AO-51 was

... continues on page 5



What is AMSAT®?

AMSAT members are a worldwide group of enthusiastic individuals designing, building and operating Amateur Radio satellites as part of our program of space science education.

The Radio Amateur Satellite Corporation (AMSAT or AMSAT-NA) is a non-profit scientific and educational organization chartered in Washington, DC, in 1969. Since then, AMSAT and colleague organizations around the world have built over 50 ham radio satellites. Fifteen of these satellites continue in operation.

Joining AMSAT supports our current projects: Eagle, AMSAT-OSCAR-E (Echo) and ARISS. Eagle is a high orbit DX capable satellite planned for a 2007 launch. Echo is a low orbit FM and digital bird you will be able to use with simple equipment, planned for launch in 2004. And ARISS is our program on the International Space Station. You will keep up to date on the world of Amateur Radio satellites with 6 issues of the AMSAT Journal every year.



We'd like to have you as a member!

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\$1200, \$600, \$300, \$120 per year _____
☐ Check here if you want to make 12 monthly Donations for the
President's Club each 1/12 of the Presidents Club total (Credit Card only).
Other donation (such as \$40, \$70, \$100, \$250, \$500) _____
TOTAL Membership Renewal and Donations in US \$ _____

Do you send QSL cards for satellite contacts? You can help AMSAT by inserting the form above describing AMSAT and providing membership information when you send your QSL's. Put one of these inserts in with every QSL mailing and will help other hams find out about AMSAT and you will help AMSAT build new satellites by helping to add new members.

Included at the [amsat.org](http://www.amsat.org) Web site are forms for single sided printing ... just print, cut, fold and mail. You can also find forms for double sided printing if you prefer.

You can find the AMSAT QSL inserts online at:

<http://www.amsat.org/amsat-new/membership/>

Rick Hambly (right), W2GPS, AMSAT President, is shown viewing the AMSAT QSL Insert. Add one to your QSL's and encourage your fellow hams to join AMSAT.





Apogee View continued from page 3 ...

reconfigured to support emergency communications as a result of the tsunami in the Indian Ocean. While no emergency traffic was conducted over AO-51 we have become more aware of the general topic of emergency communications and the planning that will need to be done if we want to be a useful participant in the future.

The VP Engineering, WA4NFY, and the Eagle Program Manager, WB4GCS, have been working to move the Eagle satellite development project forward and to find a new home for the AMSAT lab.

AMSAT's VP Marketing and User Services, WD4ASW, has assigned a new team leader for AMSAT Field Operations, Gould Smith, WA4SXM, and together they are working to enhance Field Operations and get AMSAT represented at more hamfests around the country.

Our VP Human Spaceflight, KA3HDO, has been thinking of how we can plan to have ham radio prominently included in the NASA's future endeavors, including a return to the Moon and travel to the planets.

AMSAT is evolving with a new mission and vision that will carry us far into the future. We are working to bring new and exciting activities to all our members, whether you are interested in building satellites, operating them, expanding the frontiers of science, educating the next generation of space enthusiasts or something else. To make this happen we need you. Please renew or upgrade your membership. Tell your local club about AMSAT and encourage their members to join. Volunteer your time to help staff a hamfest table. Make a donation through AMSAT's Web site. And, of course, operate using the satellites.

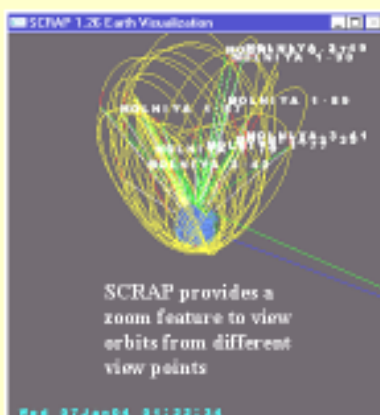
73,
Richard M. Hambly, W2GPS
President

Satellite Contact Report Analysis Prediction

AMSAT is now the North American distributor of SCRAP, a tracking program designed for ham satellite applications for Windows 95+



SCRAP provides a real-time contact report and display for over 2000 satellites on a Microsoft Windows 95+ Pentium platform.



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SCRAP

is a product of the

Bytheway Software Development Lab (BSDL)

Price is \$50 for AMSAT members, \$60 for non-members, postpaid on CD-ROM. Order by calling 1-888-322-6728, or use the online shop at

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The author, Bill Bytheway, K7TTY donated SCRAP to AMSAT. All proceeds support AMSAT.

Free software upgrades and further information can be found at

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"This is Not Your Father's AMSAT"

Barry A. Baines, WD4ASW, wd4asw@amsat.org

VP-Marketing & User Services and BOD Member

Perhaps you remember the ad slogan "This is not your father's Oldsmobile" used when General Motors unveiled a new line of automobiles that were tailored for a younger buyer than those who had traditionally purchased Oldsmobile. The phrase succinctly stated that there were significant changes to the product line and that it was important for consumers to take a second look at a changed Oldsmobile.

Have you noticed the changes that are taking place at AMSAT? Some of these changes were announced at the 2004 AMSAT Symposium after the Board of Directors (BOD) held their meeting. The BOD consists of seven individuals who are elected by the AMSAT membership for a two-year term. Four of these individuals were elected in 2003 and three were elected in 2004. Within the BOD, we now have four of seven directors (Rick Hambly, W2GPS; Lou McFadin, W5DID; Gunther Meisse, W8GSM, and Paul Shuch, N6TX) who were elected for the first time within the past three years. This is certainly a significant change as 'new blood' has been added to the BOD. The BOD in turn elected Rick Hambly, W2GPS as President, replacing Robin Haighton, VE3FRH who had ably led the organization for four years and decided it was time to turn the reins over to new leadership. Robin continues to serve on the BOD.

Another change announced at the 2004 Symposium was the BOD decision to add two new senior leadership positions and to streamline the organizational structure. The BOD recognized that after 35 years, some adjustments were needed to help AMSAT prepare for the significant challenges that lie ahead. This includes elevating the importance of AMSAT's Human Spaceflight function, which plays such a significant role in fulfilling AMSAT's education mission as well as provides such a unique and wonderful Amateur Radio capability on ISS. Consequently, there is now a VP-Human Spaceflight at the senior level. The other new position is VP-Marketing and User Services, which has responsibility for managing the marketing, sales and user services for AMSAT. This includes everything that

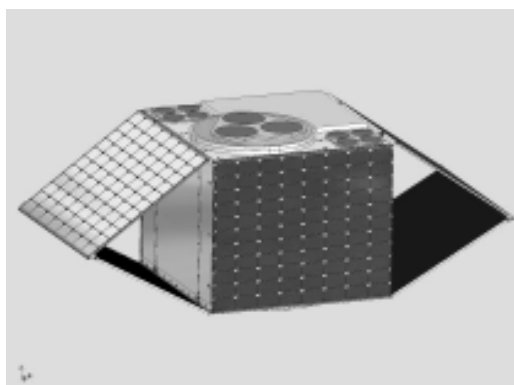
touches current and potential AMSAT members, such as publications, the Web site and Field Operations as well as membership development and fundraising. Given that AMSAT was formerly primarily focused on engineering and technical issues, the creation of this new position reflects the fact that AMSAT has matured to the point at which we also need to focus on maintaining a vibrant membership base and to create services that will attract new members and retain old ones. The BOD also recognizes the need to emphasize fundraising given the capital funding requirements of the organization, which includes the realization that greater membership support is needed to provide the resources necessary to keep AMSAT successful in the coming years. There are now nine senior leadership positions (including the President). Within this team, the Board of Directors elected six individuals who are new to this level of the organization: (Lee McLamb, KU4OS; Mike Kingery, KE4AZN; Barry Baines, WD4ASW; Frank Bauer, KA3HDO; Gunther Meisse, W8GSM; and Steve Diggs, W4EPI) plus the new President. This represents a significant transition for AMSAT. (For a listing of all the senior officers and BOD members, check the Masthead of *The AMSAT Journal*.)

Incorporated within these changes is the realization that AMSAT must be formed into collaborative teams rather than a hierarchy

as the basis for operation. The President serves as the team leader for the Senior Leadership Team. The senior officers serve as 'team leaders' for their respective functional area, with coordination of a team's activities being a key responsibility of the team leader. Within Membership and User Services, for example, the Vice President has formed a team of volunteers at the director level who in turn have responsibility for *The AMSAT Journal* (Ed Long, WA4SWJ), AMSAT News Service (Lee McLamb, KU4OS), the AMSAT Web site (Emily Clarke, W0EEC), Electronic Communications (Paul Williamson, KB5MU), Contests and Awards (Bruce Paige, KK5DO), Nets (Keith Pugh, W5IU), and Field Operations (Gould Smith, WA4SXM). These directors in turn lead their own teams that handle the details of their respective areas. The VP and directors will interact with one another as a team to enhance the overall capabilities of the Marketing and User Services team.

Now, these changes in organizational structure were not done in a vacuum. Starting in February 2004, the BOD initiated a strategic planning process that continues into 2005. The BOD created mission and vision statements in February as a result of their weekend strategic planning session in Orlando and then held bi-weekly conference calls (using a donated bridge) through the end of 2004 to continue the planning process. These calls will continue on a monthly basis in 2005. So far, the calls have covered such areas as organizational structure, 'lessons learned' from our previous projects, and fund raising.

The key step taken by the Board of Directors back in February 2004 was the creation of both Mission and Vision statements. The **Mission Statement** defines the 'who and what' of AMSAT. "AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow amateur radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators."



Eagle is expected to introduce new technology (e.g. C-C Rider - C-band antenna is not shown here) as well as more traditional satellite services (V/U/L/S-Band). Will you make a personal commitment to support AMSAT's goal of placing two of these satellites in orbit by 2012?

The **Vision Statement** defines what an organization wants to do to fulfill its mission and reflects goals for the next five to seven years. The BOD created a vision statement that is truly visionary. *“Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.”*

Think about the implications of this exciting Vision Statement. There are several key takeaways:

- While AMSAT successfully launched AO-51 into Low Earth Orbit (LEO) in 2004, AMSAT will now primarily focus on High Earth Orbit (HEO) satellites while actively supporting human space missions.
- By 2009, access to a HEO will be on a daily basis (e.g. a HEO satellite will be visible at least for a portion of a day)
- Our goal is to have assets in orbit that will allow anyone on the ground to have access to HEO satellites anytime, anywhere by 2012 (e.g. a HEO satellite is available all the time)
- To accomplish this goal, it will take at least two new satellites from AMSAT-NA (plus AMSAT-DL's Phase 3-E) to be placed in orbit so that one of the three is available to a user at any given time.

Why did the BOD embrace this Vision Statement? Clearly, AMSAT's focus has always been on pushing the technical envelope and building satellites. Our organization's 'culture' has been one of creating Amateur Radio satellites and finding ways to get them launched. If AMSAT backs away from a continuous process of having satellites in the pipeline, the natural result will be that we will lose our technical expertise as our builders look towards other opportunities and our membership drifts away due to lack of interest. Building satellites and being in the technological forefront is what brings this organization together. In addition, given that AMSAT has been so successful in placing satellites in orbit over the years, we are now not just 'builders' but 'service providers.' Amateurs around the world use amateur satellites every day. However, our assets have finite life expectancies, which means

we must always be looking forward toward replenishing 'the fleet.' That doesn't mean we necessarily replace one-for-one, but it does mean that we will push towards a goal of having satellites always available to a user on the ground. The successful implementation of this goal means Amateur Radio satellite assets will be available when needed on a continuous basis for emergency services anywhere around the world.

How is AMSAT going to accomplish this? Clearly, we're talking about long-term projects that require technical expertise, a strong group of volunteers to do the engineering and construction, and significant amounts of MONEY. AMSAT is embarking upon projects that require long lead times. A critical component is the ability of AMSAT to generate significant funds between 2005 and 2012 (in the millions of dollars). This in turn, requires a significant shift in the mindset of our organization as to how we manage projects as well as the absolute necessity of the membership to consistently financially support these projects over the next seven years.

In essence, to accomplish this goal, our membership must strongly embrace the obligation of providing financial support for these projects above and beyond their membership dues each year to provide the capital base needed to progress on this visionary path. AMSAT successfully generated the funds needed to support the Echo Launch Campaign in 2004; we must generate similar amounts of funding in 2005 and the years beyond to provide the foundation for Eagle I and Eagle II. The paradigm shift is this: Instead of making a one-time contribution for Eagle, we must ask that you consider making an annual contribution to support Eagle. If you gave \$50.00 in 2004 for the Echo Launch Campaign, for example, please consider making a donation in 2005, 2006, 2007, etc. to support Eagle. Our fundraising must reflect that since we're building satellites that will take a number of years to construct, test, and launch, money is needed each year to complete these projects. This is not a 'one shot' deal.

This approach to fundraising may be new to AMSAT but not necessarily new as far as how people donate to other not-for-profit organizations. Many people, for example, donate to their *alma mater* every year or give to a local charity year after year. Organizations have capital campaigns that

last several years. We realize that these organizations consistently need support. Likewise, we must now recognize that while the AMSAT membership dues sustain the organization and provide the funds to produce *The AMSAT Journal* and pay Martha's salary (our only employee), it is essential that additional funds be donated if we are to achieve our vision of 'continuous coverage.'

At the same time, AMSAT is looking at fundraising outside of our membership. This is a significant requirement and a real challenge. However, do not make the assumption that 'someone else will pay for Eagle.' A significant factor in generating outside support is the amount of support that is generated within the organization itself. Potential outside contributors look to see how much internal fundraising is accomplished when deciding whether to support an organization such as AMSAT. After all, those who are most likely to provide financial support for Eagle are those who are most familiar with both the organization's vision and potential benefits of Eagle. That means the membership plays a critical role in Eagle's future success. If our own membership does not enthusiastically embrace the vision and provide strong financial support, why should an outside body support it?

Consequently, when we talk about a changed AMSAT, we must also recognize that AMSAT must embark upon a sustained, multi-year fundraising campaign. We also realize that unless the membership strongly embraces the ideal that with membership comes an implicit obligation to financially support these projects year-after-year, we will be hard pressed to achieve our vision. This means that each of us has a personal stake in the determining the successful outcome of achieving our vision.

AMSAT is indeed the not the same organization as in years past as we are now dealing with a new environment and new expectations. While we have a proud history of accomplishment, we have now embarked on a new set of challenges based upon a new vision and are lead by a new team. Your sustained personal support is critical to the successful accomplishment of this vision and to ensure AMSAT's future success. We welcome your feedback and suggestions as AMSAT moves ahead towards an exciting future. ☺



A Short Introduction to Using Your FT-817 and Arrow™ for SSB Satellite Demonstrations

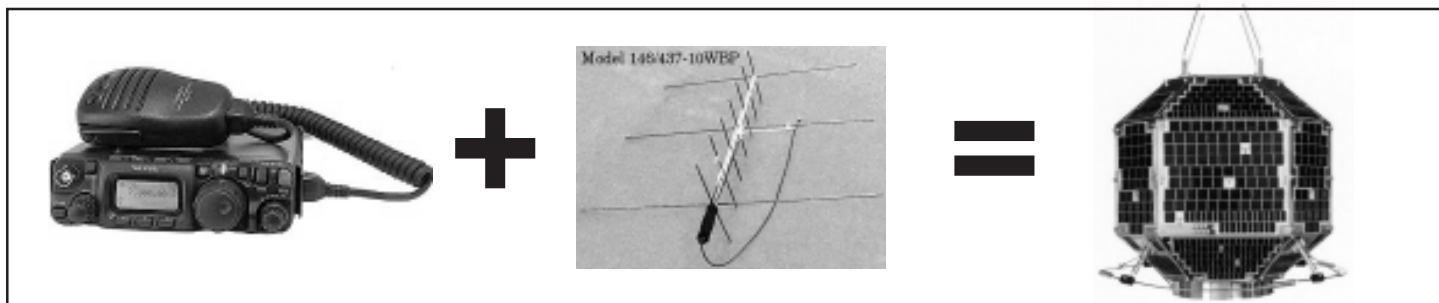
by Andrew Glasbrenner, KO4MA, ko4ma@amsat.org

This article describes my successful experiences using the Yaesu FT-817 portable radio with an Arrow antenna to demonstrate satellite operations on linear

changes to 145.930 LSB. Do all the pre-pass preparations you normally do for an FM bird.

The Limitations

There is a combination of factors that makes this all work. While most of us understand why it is important to only operate full



transponder satellites. During the time before AO-51 was launched, after UO-14 died and AO-27's operation was moved to evenings, I and fellow Area Coordinators were in a bit of a pickle when trying to do satellite demonstrations at hamfests. SO-50 was working, and easy to use, but the time it comes over each day changes at a fairly rapid pace leaving passes outside of hamfest hours on some weekends. I needed something to fill the gap. Some experimentation led to the following procedures to making good demonstrations on FO-29 and sometimes AO-7.

The Equipment

- Yaesu FT-817, preferably on a shoulder/neck strap
- Standard Arrow satellite antenna, or similar
- Most everything else you have for a regular FM demonstration

The Setup

Hang the FT-817 around your neck where it is easy to look down and see the display. Set VFO A to 145.930 LSB, VFO B to 435.805 USB. From VFO B engage split mode. If you have an Arrow with a diplexer, attach it to the front BNC. Then check to see that both VFOs/bands are set to the front antenna. If you have an Arrow without the diplexer, run one cable to the rear connector and one to the front. Configure the antenna menu option appropriately. I find it easier if the cables are well labeled, and my rig's finals appreciate the proper VSWR with them attached to the correct antenna half. Key the microphone and make sure the frequency

The Pass

As FO-29 rises you should hear the beacon somewhere around 435.805 sending telemetry in CW. Get a feel for polarity and direction doing the standard Arrow swing and twist. Polarity makes a big difference so you shouldn't use a tripod unless you have to. When you feel comfortable, tune slowly up to about 435.870. You'll probably hear some noise around 435.850. This noise is a product of the transponder that has appeared in the recent year or so. If you are lucky you'll hear some traffic around 435.855 to 435.865, and you may be content to listen to these as you answer questions from the onlookers. Now the fun part - I usually try to make prior arrangements to have an experienced operator looking for me around 435.870 down/145.930 up. If someone is listening for me I'll give him or her a long call, then tune up and down 5-6 kHz on receive listening for his or her reply. Although before my time I imagine it is not unlike using a crystal bound transmitter and a tunable receiver. If you don't have a prearranged QSO, feel free to call CQ. I always mention "half duplex, long calls please" so others know I need to tune around some to find them. Leave your uplink fixed. If you find yourself calling CQ more than a few times with no response, you may want to tune your receive back down the band to find a signal to peak up your pointing. Sometimes, and with practice, the noise floor from the satellite is enough to point the antenna by at high elevations.

duplex on the FM satellites, those same problems are almost nonexistent on FO-29. By choosing an uplink frequency other than the most popular ones near the center of the passband we avoid collisions with other users. With only 5 watts and ~6 db of gain we are unlikely to overpower the satellite on the uplink. However, these differences should be explained to the observers and we should avoid half duplex demonstrations on any FM satellite.

The Next Steps

AO-7 can be worked the same way, with a few complications. When AO-7 emerges from eclipse, the mode it starts up in is somewhat random. Most passes seem to be in Mode B with activity around 145.950 downlink/432.150 uplink. The difficulty is in demonstrating AO-7 when the mode is unknown or uncertain. I have on occasion heard the Mode A downlink on a Miracle Whip antenna but it is usually pretty weak and of limited use for a demonstration of this type. Luckily, the upcoming mode B VU sat satellite from AMSAT-India should be very easy to work in this manner.

Other possibilities for expanding our portable demonstration abilities include Mode V/S on AO-51 and Mode U/S on the upcoming SSETI satellite. QSO's have already been made on AO-51 V/S with 2 HTs, an omnidirectional antenna on 145, and a handheld patch and downconverter on 2.4 GHz. I look forward to hearing about your demonstrations on the satellites, and am always available at ko4ma@amsat.org. ☎

AMSAT Eagle Update

**James A. Sanford, PE, WB4GCS, wb4gcs@amsat.org
Eagle Project Manager**

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012...

Eagle is being designed as the SECOND phase of implementing the vision quoted above. What's the first? P3E - currently being built by AMSAT-DL. Why do we care? Because Eagle will share many components with P3E. Why? Because we get more bang for the buck or man-hour. In particular, since P3E will lead Eagle by some time, common components and systems in Eagle will benefit from the testing already performed and experience already acquired by the P3E folks. We also get a lot more eyes looking at each shared component, which can only give us a better satellite.

So, where do we stand with Eagle? **Anxious users want to know!**

Eagle remains very much in the design phase. Some aspects (structure) are merely paper - actually a collection of highly detailed CAD files. Others (C-C Rider) are concepts, being explored - with real hardware. Still others, (CAN Bus and IHU-3) are real live hardware, being programmed and tested!

We're doing a few things different with Eagle than any prior satellite. First, openness. We intend to completely share all that we can. The only things not shared will be proprietary things, for which we must sign a non-disclosure agreement (as of this writing, there are NONE), intellectual property, the originators of which do not wish to share (NONE to date) and command "things" which are obvious. We may get to the point where some things can't be shared due to ITAR rules - we're not there yet.

I hope to publish an article on Eagle progress in each Journal. Sometimes it may not say much more than, "Testing of xxxx continues..." but you'll know where we are. I intend to answer all inquiries I see on the AMSAT-bb, or receive addressed to me. Our infrequent meetings will be open to the

AMSAT public, as discussed long ago by our AMSAT President, Rick Hambly, W2GPS.

Second, we've instituted a practice of Peer Review. Academia has used this practice well for many years. Some industrial concerns have enjoyed similar success. The Eagle team believes that more eyes on target is always better. To that end, if you're interested in reviewing a design or concept, please let me know directly, or better yet, sign up on the Volunteers page of the AMSAT web page.

Third, we're adopting some Project Management concepts. We're developing an integrated schedule. Once we know what it will take to build Eagle, THEN we'll seek to finalize a launch opportunity. (The search for potential opportunities is ongoing.) The value here is that we'll proceed in an orderly fashion, rather than a mad scramble to make a certain launch date. I don't ever want to see again what Chuck Green went through in the last few weeks before Echo was launched!

Comments? Questions? Complaints? Address them to me.

And now, some details of some recent Eagle activities.

The Software Defined Radio (SDR) team has obtained several pieces of hardware to begin prototyping, modeling and characterizing the software transponders. Tests will range from baseband to C-band, using linear transverters initially. They are starting with Digital Signal Processing (DSP) software that is ALREADY WORKING in other applications. For more details on the SDR, see the Proceedings of the 2004 AMSAT Symposium.

The C-band folks have obtained some evaluation boards for some of the microwave modules we may use. These will be carefully evaluated to help us decide whether to go with an active array of antenna/tx/rx modules or a single higher power amplifier and a single antenna. Patch antennas will be employed for the active array - easy to accurately fabricate in quantity at this frequency. We need to characterize the modules to assess the efficiency - both DC

power requirements and heat removal needs will be significant issues. I'm excited about this, because if we can make the active array work, we gain some significant capabilities - graceful degradation and software beam steering, to name two. The last time I saw an active array used at these frequencies, yields were higher than predicted, efficiencies were greater than predicted and costs were lower than predicted. And that was a GOVERNMENT project! I'm also excited because C-C Rider offers the possibility of an affordable microwave satellite station that apartment dwellers and hams in antenna restricted neighborhoods can use - we're talking LOW profile. For more details on C-C Rider, see Tom Clark's articles in the Journal, and in the Proceedings of the 2004 AMSAT Symposium.

The propulsion team is evaluating a range of possibilities. What? PROPULSION?! Yes, even though one of our KISS goals was no propulsion, it became very clear at our July 2004 meeting that propulsion was going to be required. Fundamental laws of Physics are, in fact, fundamental. Fortunately, we don't need anything as powerful or sophisticated as what was flown on AO-40. We ARE looking for something SIMPLE. Ken Erlandes has been analyzing probable initial orbits and it's looking like we'll need propulsion, but have a reasonable time after launch to make the "burn". The Eagle team has been blessed with the donation of some very sophisticated orbital modeling software - thanks to Ken and Rick Hambly.

We've decided that inter-module communication will largely be performed by the CAN-DO modules, exploiting the CAN bus, which was successfully tested in AO-40 (and many automobiles!) This hardware exists, in quantity, and is being tested now. Chuck Green informs me that one hundred modules have been fabricated, with forty designated for Eagle - more than I hope we need, which leaves some for "Son of Eagle" - the THIRD phase of implementing the AMSAT vision. Check out <http://can-do.moraco.info/> for details on this neat concept which will greatly simplify wiring on Eagle.

continued ...



Finally, the housekeeping computer, known as IHU-3 has been built as a prototype and is being evaluated. IHU-3 will allow us to get away from IHUs based on processors that are no longer being produced. It is capable of running some of the SDR code being developed; the design team is looking at using some of the Forward Error Correction (FEC) features proposed by Phil Karn and proven on AO-40 for command links. IHU-3 is one of the components being shared with P3E (and other projects), which bodes well for Eagle. It has been decided to program IHU-3 in IPS to exploit the expertise that exists in AMSAT-NA and AMSAT-DL. Desktop versions are being developed to allow modeling and simulation prior to actual testing on the IHU-3 module. Some of the software modules have already been written.

A recent P3E meeting in Germany was attended by several AMSAT-NA and Eagle team members. Can-Do! and IHU-3 were big topics of discussion.

Finally, what does the Eagle team still need? First, money - if you haven't yet, please contribute to the Eagle development and launch fund. The hardware to support these development efforts is not free. Once we start "bending metal" we'll incur significant expenses. The thermometer on the AMSAT web site is looking awfully empty. We could use volunteers with all kinds of capabilities, particularly microwave RF designers with experience using, and with access to, microwave CAD tools. We're also seeking long term relationships with universities. If you have contact with a university that might be interested in such a relationship, please let me or Rick Hambly know. Finally, if you have time and talent to offer, please sign up on the volunteer page on the AMSAT web site.

In summary, Eagle remains in a preliminary design stage. However, we are making concrete progress - design decisions have been made, hardware exists and is being tested, and some of the innovative concepts are being actively tested. Progress, however slight, remains progress! Please contact me with comments, complaints and suggestions at: wb4gcs@AMSAT.org 📧

The Lightest Satellite Station in the World?

Pedro, EB4DKA, (below) recently demonstrated how small an amateur satellite station can be when he had a QSO with ON5NY via the SO-50 satellite. Pedro used just an ordinary Alinco DJ-C5 credit card HT with the DJ-C5's own antenna. He was running just 300 mw of FM and the complete station weighed only 85 grams!

The uplink frequency for SO-50 is 145.850 MHz and the downlink can be received on 436.795 MHz (+/- Doppler shift of 10 kHz). When transmitting a CTCSS tone of 74.4 Hz is initially required to arm the 10-minute timer on board the satellite then a tone of 67 Hz is needed during your transmission.

At AMSAT-UK's Space Colloquium, which runs from Friday 29th to Sunday 31st July at the University of Surrey, Guildford, England there will be special sessions for beginners to teach them how to use the FM satellites.

For details on the Space Colloquium contact: Jim Heck G3WGM.

Tel: +44 1258 453959

Email: g3wgm@amsat.org

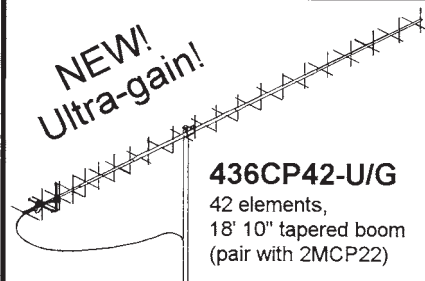
Web site: <http://www.uk.amsat.org>

Pedro, EB4DKA's Web site: <http://www.eb4dka.tk/> (Note: it's all in Spanish)



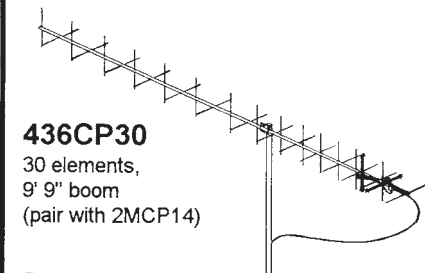
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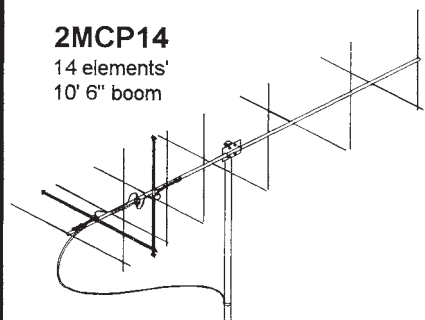
436CP42-U/G

42 elements,
18' 10" tapered boom
(pair with 2MCP22)



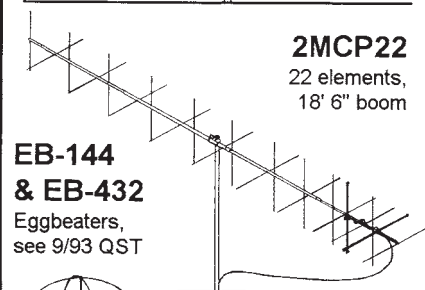
436CP30

30 elements,
9' 9" boom
(pair with 2MCP14)



2MCP14

14 elements'
10' 6" boom

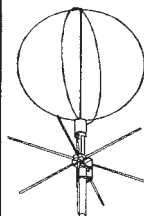


2MCP22

22 elements,
18' 6" boom

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Okay, Guys and Gals,

The first two submissions for this award have arrived in my e-mail account (on the same day). Due to the fact that some people that are not members of the -BB or do not get the *Journal* or whatever might not have an equal chance to work towards this award, I have decided to leave the initial submission period open until midnight February 7. At that time, I will take all the submissions received and put them into a hat and draw for the order of issuance.

Remember, this award is the only valid in 2005. Rules for this award follow.

The AMSAT 51 on 51 Award is given to any station that makes contact with 51 different stations on AMSAT's newest satellite, AO-51, during the year 2005. The award is designed to promote friendship, and encourage contact with handheld and first-time satellite users. Applicants are encouraged to include contacts with stations making their first satellite contacts.

Contacts may be in any mode (Voice/Packet/PSK-31) and on any band (V/U, V/S, L/S, L/U, H/U). To receive the award, you must submit your log entries either electronically or by photocopy. Entries must indicate date and time (UTC) of the contact, call sign and grid square of the contacted station, and mode used.

Only contacts made between 1 January, 2005 and 31 December, 2005 are eligible. Logbooks may be submitted until 30 April, 2006. QSL cards are not required, however logbooks may be checked against other applicant's logs.

Production costs for this award have been underwritten by an anonymous donor to honor Robin Haighton, VE3FRH, who served as AMSAT President during the construction and launch of AO-51. Consequently all award fees will be applied to the AMSAT Eagle fund.

The donation for the award is \$10.00 (US Funds) and AMSAT members receive a \$5.00 discount. Award fees may be paid through the AMSAT Online Store once you have received confirmation of eligibility from the Director of Contests and Awards.

73,

Bruce Paige, KK5DO

AMSAT Director Contests and Awards

AMSAT is the North American distributor of SatPC32, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP.

Version 12.2 now supports Labjack U12 and W0LMD rotor controllers and Doppler tuning for Yaesu FT-817/857/897.

Features:

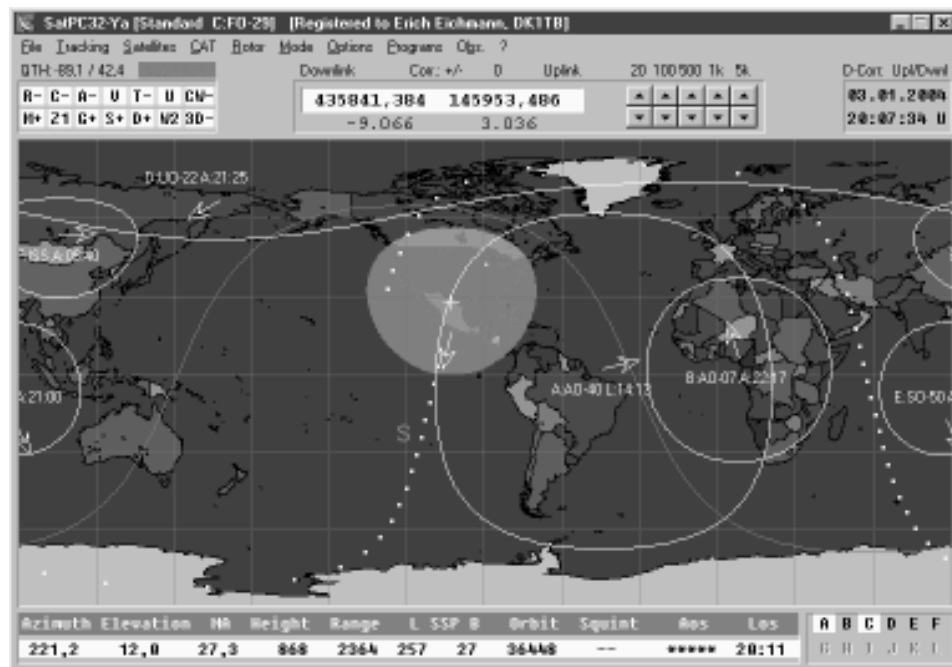
- Graphical tracking on a world map with two selectable Zoom factors.
- One-click satellite switching using 12 "letter" buttons.
- Automatic rotor control support for: Kansas City Tracker/Tuner, FODtrack, Uni_Trac, SatEL, Labjack U12/Piggyback, W0LMD Mini/Junior/Senior Trackers, Yaesu GS-232, ARS from EA4TX, EGIS rotors, IF-100, RIF-PC, AMSAT-DL interface, WinRotor32, HalloRotor, and WiSP DDE clients.
- Doppler tuning with on-screen frequency displays. Radio models supported: Yaesu FT-847, FT-736R, FT-817, FT-857, FT-897 ICOM IC-820H, IC-821H, IC-910H and other ICOM radios Kenwood TS-790 and TS-2000 DDE client programs
- "Transparent" VFO-knob tuning in addition to keyboard and mouse tuning.
- "Virtual" VFO tracking for half-duplex transceivers FT-817, FT-857, FT-897.
- Includes a special version for ISS split-frequency operation.
- Controls subaudible tone on FT-847, FT-736R, FT-817/857/897, and IC-910H.
- Includes a non-graphical version and programs that output lists to the screen, printer, or a file.
- Interfaces with WiSP, with user-defined satellite switching priority.

Price is \$45 for AMSAT members, \$50 for non-members, postpaid on CD-ROM.

A demo version may be downloaded from <http://www.dk1tb.de/indexeng.htm>
A registration password for the demo version is \$40 (members), \$45 (non-members).

Order by calling 1-888-322-6728, or use the online shop at www.amsat.org.

The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.



Alaska Trip and FO-29

by Elvin Kingery, WA4HCT, wa4hct@amsat.org

I would like to tell you about a trip my wife Dorothy, AD4PJ, and I made to Alaska last summer and the fun we had using ham radio along the way. We set up a schedule with our son Michael, KE4AZN, on the satellites and on HF. We started out with a schedule on SO-50, FO-29 and HF.

We modified the schedule as the trip progressed and as conditions changed. We traveled in a 1977 Chevy Cheyenne pickup with a metal topper on the truck bed. I made

Alabama, and the locations I thought we would most likely be in. I entered locations into my tracking program so I could get data for AOS, LOS and altitude to make it easier to find and track the satellite while using the beam antenna.

We started out with a very ambitious schedule, and we knew at the time we would not be able to maintain it but decided to make the changes as we saw the need. We were to make a contact each day on SO-50, FO-29 and HF. After poor luck on HF, we changed that part of the schedule to Monday, Wednesday and Friday. Because of the burden created to meet two satellite schedules for us traveling and Michael working we decided to drop the SO-50 schedule except for special times or locations. We could pass any information and get, for the most part, the same grid squares with FO-29. Also, operating on FO-29 is much more fun for me.

Dorothy and I had previous experience operating on FO-29. We had practiced portable at home and I had worked the satellite from my home station. We had also used it during a trip from Tennessee to Oakland CA two years ago and a trip to the Northern Michigan peninsula around to Dodge City, Kansas and back to Tennessee last year. So we did have some experience with portable and mobile operations.

Our operating technique was to plan ahead as best we could, to find a turn-off that would give us a reasonably clear view of the sky. We almost always used the beam and would set it up on a camera tripod near the truck. However, we do have good luck with the 5/8 wave whips also. I would operate the radio while

Dorothy would direct the antenna. She would wear a head set to be able to hear the incoming signal better and point at the satellite using the signal as a direction finder. She did a great job. We would get the parameters for Dorothy using our notebook computer and tracking program before each pass. I would adjust the frequency to compensate for the Doppler effect to keep the received frequency on Michael's signal and do most of the talking. During the easier passes, Dorothy would get in a few comments also.

We had our GPS with us and Dorothy would always take a reading before a pass. During each QSO we would give our coordinates as well as our position relative to a town or major terrestrial site. I was not able to find a grid square map for Canada or Alaska so we used the GPS readings to determine the grid squares for the QSL cards after we returned home. I ended up making my own grid square map from road maps we had gotten on the trip. The road maps had the coordinates on them that made it relatively easy to determine the grid squares. Our locations were very accurate.

We made contacts almost daily all the way to Alaska. I enjoy especially making ham contacts in National Parks and at special



a bed up about 10 inches off of the floor. We stored our spare parts, camping equipment and clothing under the bed and in plastic drawers. We had another smaller set of drawers we used for our cooking equipment and food supplies near the back.

Our ham equipment included a Yaesu FT-847, a 70 cm pre amp, 2 meter and 70 cm 5/8's wave whip antennas, home brew 2 meter and 70 cm beams, the Hustler mobile whip with a set of top loading coils and a notebook computer. The computer sat on the seat between us. I built a dual level table to hold the radio and antenna tuner as well as other small equipment. It was placed on the floor between the passenger and driver. I had antenna switches to select the antenna I wanted.

Before leaving home I made a copy of the schedule for SO-50 and FO-29 telling me when they would be visible in the lower 48 states, Canada and Alaska. I made up a schedule of those passes I believed to be the best for Michael, who lives in lower



Dorothy, AD4PJ, aims the Arrow antenna.

locations. We talked to Michael on SO-50 with a handheld radio at my cousin's cabin in the mountains south of Douglas, Wyoming. We talked on FO-29 at Little Big Horn National Monument in Glacier



Elvin, WA4HCT, works the birds on schedule.

National Park, Jasper National Park of Canada and at numerous locations along the Alaska Highway before getting to Alaska. At times it was difficult to find a place to pull off the road and not have a mountain preventing a good view of the sky. We did not mind because of the great scenery we were privileged to be in. We just worked harder to find a spot that would work.

One of our goals was to have a good QSO in Alaska on FO-29 with Michael. The conditions kept getting more difficult as we got farther from the lower 48. Some of it was caused by the fact that Michael was on one edge of the footprint and we were on the other edge. When we got into Alaska we were able to make a contact but it was not like I had hoped for. We decided keeping the schedule was starting to interfere with our touring and causing a burden for us. We agreed to stop the satellite schedule until we were to leave the state but continue trying HF.

We made 20-meter contacts in Denali National Park, Homer and Valdez, and picked a time to get back with our schedule on FO-29 before leaving the state. As luck would have it, we were scheduled for a pass when we were about 30 miles from the Canadian border. We had a great QSO at that location which satisfied one of our important goals. After a few more contacts, Michael got busy with the operation and testing of the new ham satellite, Echo/AO-51. We decided it was too much for him to continue with the schedule, do the testing and operating Echo and work his job, so we stopped the schedule. Dorothy and I did, from time to time, get on FO-29 and made

some contacts including one in Theodore Roosevelt National Park after we had returned to the lower 48.

We had a great time on the trip. We traveled 11,001 miles and were gone almost six weeks. We made 30 contacts on FO-29, 13 on SO-50, 19 on HF and worked in 21 grid squares. While I am sure this is not impressive to most, I was very pleased and

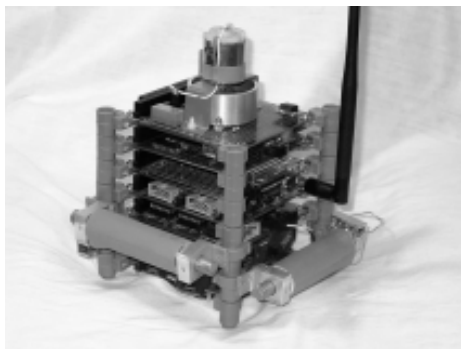
proud of our accomplishment. After all, our primary intent was a camping trip to Alaska, not a ham expedition. We provided some rare grid squares for some people. It certainly added a new dimension and something unique for a camping trip. Try it some time.

The Canadian and Alaskan people were very nice. It was a treat to strike up a conversation with them and later realize how much we learned listening to them. We met two couples from our hometown, Chattanooga, TN. We met a couple, Alaska residents, that were born and grew up within a few miles of where I had lived the first 18 years of my life in Iowa. Like the old saying goes "It is a small world".

I am very impressed with the performance of FO-29. We were able to make contacts consistently and when the satellite was at a very low altitude. It takes a little practice to be able to work FO-29 but it is not overwhelming. It would be good if more hams would use it and get comfortable with its operation. I get as much satisfaction having a QSO on it as any other ham mode or system. I think you would find it fun and rewarding. Give it a try if you have not already. Also, I ask you to give your support to AMSAT to continue the fun and knowledge from working with ham satellites. 🌐



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News Release

To: **ANS, The AMSAT Journal, BoD**

Date: 1/10/2005

From: **Gunther Meisse, W8GSM, AMSAT Treasurer**

AMSAT members "pitch-in" on work that would cost AMSAT thousands of dollars each year to duplicate. We are wrapping up 2004 totals and we have expanded the eligible activities for 2005 reporting.

If you are interested and have not yet joined the AMSAT VRS (Volunteer Reporting System) please review the material below and, if you qualify, send an e-mail to the AMSAT Treasurer, Gunther Meisse, at in-kind@amsat.org to sign up for this valuable AMSAT program.

The time you donate will serve to enhance the appearance of our financial statements, comply with Generally Accepted Accounting Principals (GAAP), all with the hope of "putting on a better public face".

- In-kind donations are not necessarily tax deductible by the volunteer. Please advise a tax consultant if you have any questions.
- Your submissions will be kept confidential. Only the total dollar values will be released.
- The aggregate value, within each category, will be moved to our financial statements, listed under the appropriate category as "In-Kind Services."

AMSAT In-Kind Volunteer Time Donation System (Revised in 2005):

In keeping with the AMSAT mission statement we are seeking documentation of In-Kind hours for the following categories:

Satellite Development/Operations

- Satellite Design
- Satellite Construction
- Satellite Ground Control Operations
- Software Development
- Educational Outreach
- ARISS Design & Construction
- ARISS Ground operations (School Contacts)
- Journal Editing
- Journal Writing
- ANS Editing
- ANS Writing
- AMSAT Publications
- (Example: "Echo Operation, Development & Specifications")
- University Lecturing or mentoring

- University Satellite meetings (Micro & Cube etc)
- Hamvention activities including manning booths, making presentations and the like.

Member services

Projects related to extending our mission to the general Amateur Radio community and the general public

General operation of the organization

If you spent volunteer hours in any of the above categories and you have a good sense of the total hours you are spending, we would like to know about it.

We need an hourly rate to assign to the hours you log. The procedure for your selection of that rate is as follows:

We ask you to determine your attributable hourly rate based on your judgment of what the value is, based on the specific work you did for AMSAT. AMSAT will create an internal value list which we will compare against your number to be sure we are not grossly over or under stating these values.

When you select an hourly rate, please be conservative, but absolutely realistic.

As an example: An engineering PhD may figure he was doing entry-level work on one project. We wouldn't want to use \$250 an hour for a project that an engineer, fresh out of college, may be able to complete at a rate of \$30.00 per hour. Please be as realistic as possible.

If you feel you qualify and would like to participate, your e-mail responses to in-kind@amsat.org should include:

- Your Name
- Your Call sign
- Your e-mail address
- The name of the qualified project you participated in, and when
- The hourly rate you feel is reasonable
- Total hours you spent in this AMSAT endeavor.
- Multiple projects, which should be calculated at different hourly rates, should be separately listed.

In-kind Services to AMSAT Just another way you can make a difference in the future

of satellite Amateur Radio around the world.

We hope to hear from you. If you have any questions regarding the program you are encouraged to send them to the same e-mail address, in-kind@amsat.org. 



Activity in OSCAR SKN 2005 was up significantly from last year, especially in western North America where Cliff, K7RR, reported that the FO-29 passband sounded like 40 meters!

Eight SKN participants received at least one Best Fist nomination:

Frank Riedel, DJ3FR
Bill Erhardt, K7MT
Cliff Buttschardt, K7RR
Ron Gorzynski, K8DID
Frank Wiesenmeyer, K9CIS
Al Ozias, N7EQF
Diane Bruce, VA3DB
Kerry La Duke, WC7V

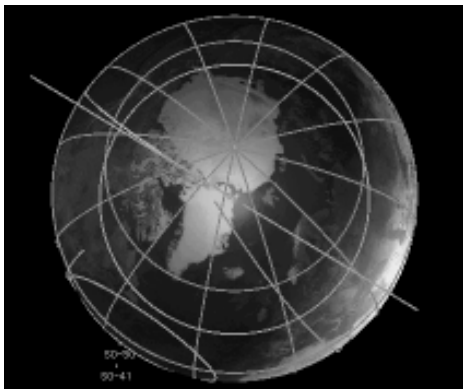
Congratulations to all of our Best Fist winners, and CU next year!

73,
Ray Soifer, W2RS
for AMSAT-NA 



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MacDopplerPRO X gives you a seat right in the heart of the Operations & Command Centre for every satellite in orbit. In fact up to thirty two front row seats at the same time, providing any level of station automation you need from assisted Doppler Tuning and Antenna Pointing right on up to fully automated Satellite Gateway !

It will calculate the position and relative velocity of the satellite you are tracking and automatically adjust the Doppler shift on both transmit and receive as well as pointing your antennas with predictive dead spot crossing so that a pass is never interrupted by the beam heading passing a dead spot.

MacDopplerPRO X provides separate windows for the map (2D or 3D), the radio controls, and the sorted table of upcoming satellite passes. A Horizon window graphs upcoming passes as a function of elevation over time for status at a glance.

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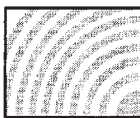
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First Kid's Day on AO-51 (AMSAT Echo)

by Mike Kingery, KE4AZN, ke4azn@amsat.org

Beginning at 1412 UTC on February 5, 2005, and running until 0258 UTC on February 6, 2005, AMSAT-NA and the Echo Command Team held the first ever AO-51 Kid's Day event. AO-51 was setup in V/U FM repeater mode, and the command team requested that only kids or adult operators making contacts with kids operate during the event. Immediately after the mode setup was completed, kids started making contacts. There was a "Kid to Kid" contact at the very onset of the event, with Jeff, KB2M, making contact with Julia, KA8HQL.

The command team would like to thank the satellite operators for standing by and allowing this event to be successful, and big congratulations go out to the amateur operators that helped kids enjoy the event. We will do it again soon!

Here are a few messages and pictures that were sent to me from some of the participants during AO-51 Kid's Day.

This is from Jeff, KB2M, operating with his son, "Jeff Jr. had a lot of fun working AO-51 today. After a bit of coaching he was working the bird like a champ. In fact, I had to slow him down a bit to give some other kids a chance! This is yet another great use of an FM LEO, great idea." Here's what Jeff Jr. had to say, "I had a lot of fun working the satellite. When is the next time you're going to let me do this?"

This message is from Pete, NA2P. "My kids, Peter 5-1/2 and Rachel 2-1/2 worked, well said hi, to Des, G6HRH, in IO70 and Dave, G1OCN, in IO80 at 23:49 on 2/5/05, Kid's Day on AO-51. The pass was short and the elevation quite low but the satellite was full quieting no less. Once in a while the kids do come into the shack looking to talk on the

radio, but not much. The DX bug hasn't got a hold of them yet."

This is from Jeff, KA8HQL, about operating the satellite with his girls. "Thank you so much for this opportunity to make a couple of little girls so excited. My oldest, Julia, age 9, was calling all over telling family and friends about the experience. She made several contacts. Katie, my 6 year old, was



Peter and Rachel operating DX on AO-51 from NA2P.

also very excited. Although I don't think she grasped the idea of an orbiting satellite. The satellite sounded great. It was 20 over 9 off the side of my 18 element horizontal M2. Wow, I now wish I had planned a little better to have some of their school classes out. This is just the type of thing that gets people interested. My first contact with Amateur Radio was a set-up at a mall in Athens, OH. I was 10 years old. They only had a 2m rig to a dipole talking on a repeater, but that was what set my heart on radio for almost 30 years now."

This one is from Rick, WA7ZVO, about his son's participation. "Here is my son Mike, age 12, in the front yard of our Tempe, Arizona home. He has my Yaesu VX-5R and the Arrow hand held Yagis. He had a grin from ear to ear after his contact! He is an honors student in middle school and after yesterday I think he's an aspiring ham and satellite watcher, too!"

This message is from Aruni, VE4WMK, who has become quite a proficient satellite operator herself in a short time. "Thank-you so much for re-scheduling the Kid's Day. We had a nice contact with Bill, K7MT, from Montana. My sister and brother had their first ever excitement on Echo with him. I think Bill really enjoyed listening to my 5-

year-old brother. They enjoyed talking on the satellite so much. They want one more "Kid's Day soon. Though I invited a few of my school friends for this event, none showed up, probably due the cold, windy weather here in Winnipeg. Once again, thank-you for your kind thoughts for letting us have this fun."

Logan Holden of Boy Scout Troop 850 participated in AO-51 Kid's Day with several contacts made on 2 separate satellite passes over Guthrie, OK. His father, W5MPA, assisted him.

This note is from Bob, KW3F, who was assisted by a youngster in getting started with satellites. "Here's a twist on Kid's Day that I think is really very cool. I'm a 53-year-old 'kid' that was assisted by a fine young ham from Winnipeg, in making my first two satellite contacts. That young kid is Aruni, VE4WMK, AMSAT Member #35560. I'm brand new to working the satellites. I stumbled across an ad or link concerning the Arrow II and thought 'this'll give me something new to try'. I started doing some research, and I subscribed to this mailing list about 3 weeks ago. Aruni had posted a message telling of her success with the recent QRP day event and that she was using an Arrow II and an IC-W32A. I e-mailed Aruni and asked some questions, and for some advice, about gearing up and getting involved. Well, a couple of e-mails back and forth, some tutoring on how to program the memories of the HT for Doppler etc., and I had success with SO-50 and AO-27 today. I think I'm going to get hooked on this. I'm already looking towards a FT-847."

"I didn't have a clue about Aruni's age until about our third e-mail exchange. She is 10 years old. YAY! There still is hope for future



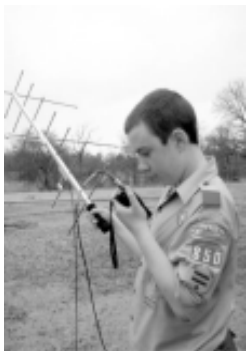
Jeff operating as KB2M.



Mike operating WA7ZVO from the front yard.

Hamsat Nearing Launch

by Nagesh Upadhyaya, VU2NUD, vu_ham@yahoo.com



Logan operating AO-51 as W5MPA.

generations to carry on this great hobby. When I learned she was 10 I immediately thought about my first hamming experiences 40 years ago. It brought back good memories."

"Thanks Aruni! You helped in more ways that

just getting me going on this segment of our hobby. And I hope we soon get to work each other on the birds!"

This is from Bill Russell, a message about his sons' participation during Kid's Day. "Here are a few pictures of my kids, Ethan Russell, Ryan Russell and a friend of



Ethan Russell and friend Carlos Bravo.

Ethan's, Carlos Bravo (in black) taking part in Kid's Day Saturday, Feb. 5th 2005. They had a blast!!!! No contact on this end because of a lot of other kids making the contacts. They got a kick just listening to the other kids talking and making the contacts! It was a beautiful day here in Waco, TX. And with 2 passes in the morning it was awesome to get the kids outside and involved with such a great program! In my opinion Kid's Day should be done more often, like once a month or every 3- 6 months or so! Really, the kids enjoyed it a lot!!!! The club that I am with, HOTARC (Heart of Texas Radio Club) is thinking of having a future "Satellite Field Day", with kids around town."



Bill Russell, K5WAR, with sons Ethan and Ryan.

Keep on eye on the AO-51 schedule for the next planned Kid's Day. Lets make it bigger and better the second time around. 📡

This is satellite is known as VUSAT by most hams. This is Indian Space Research Organization's (ISRO) theme-based micro-satellite. The Hamsat micro-satellite is India's contribution to the international community of Amateur Radio operators. This effort is also meant to bring ISRO's satellite services within the reach of the common man and popularize space technology among the masses.

It is a cuboidal structure of 630mm x 630mm x 550mm with a mass of about 40kg. It has aluminum honey-comb structure with passive thermal control. Hamsat will be flown in a near-circular polar Low Earth Orbit (LEO) of about 817km. Body mounted solar panels and COTS (Commercial Off The Shelf) Lithium-Ion batteries are the main source of power. The satellite will spin at a rate of about 4 RPM with the spin axis orientation being ± 3 degs. Spin stabilization is provided with on-board autonomy. A tri-axial magnetometer and twin slit sun sensor with magnetic torquers act as actuators providing the required inputs to the bus electronics. Bus electronics consist of a MAR31750 processor. This system also provides attitude control, telemetry and telecommand for the satellite.

Communication for the satellite is on VHF (137 MHz for TM and 149 MHz for TC). There are two payload transponders – Indian

and Dutch. AMSAT-India was involved in the development of the Indian transponder whereas the Dutch transponder was delivered by William Leijenaar, PE1RAH. Both these operate in Mode-B with a 435.25 MHz uplink and a 145.90 MHz downlink. The Indian transponder is identified by an unmodulated carrier on 145.936 MHz and the Dutch transponder has a CW signal on 145.860MHz. The output power is about 30dBm. Bandwidth is 60 kHz for the Indian transponder and 50 kHz for the Dutch transponder. Only one transponder will be 'ON' at a time. Antennas are turnstile and are common for TM/TC and payload transponders.

Apart from MAR31750 processor-based bus electronics, COTS Li-Ion batteries and Ga-As solar panels, other new technologies incorporated are a microstrip VHF 180 degree hybrid coupler, microstrip 4-way power divider and a negative-B dot law system for attitude control.

Programmed tracking of Hamsat will be carried out by ISRO's two stations at Bangalore and Lucknow. Launch will be from SriHari Kota Launch range (SHAR). Hamsat will be a co-passenger with another of ISRO's satellites known as IRS on a Polar Satellite Launch Vehicle (PSLV). Hamsat is likely to be launched during first quarter of 2005. 📡



Nagesh, VU2NUD, and William, PE1RAH, in front of the Hamsat satellite. Nagesh is the Indian pioneer who proposed and initiated the Hamsat satellite. William has given the Dutch transponder for the satellite. Photo courtesy of PE1RAH.



Amateur Satellite Orbit Basics

G. Gould Smith, WA4SXM, wa4sxm@amsat.org

In Part One of this series, we talked about the various launch sites around the world. The location of these launch sites has a great deal to do with the type of satellite and the orbit that satellite can attain. Here, in Part Two, we will talk about the different types of satellite orbits and how the satellites get into these orbits. Part Three will talk about the different type of launch vehicles that take the satellites into these orbits.

Most of us take the orbit of the amateur satellites for granted. We know about the two types and the basic tradeoffs between LEO and HEO satellites.

LEO: less expensive, multiple short passes every day, quicker to build and test, stronger signals, smaller satellites and more launch opportunities.

HEO: very expensive, long windows two out of three days, long build and test times, weak signals, larger satellites and fewer launch opportunities.

But, remember that the orbit of the satellite defines the type of satellite: Low Earth Orbit (LEO) and High Earth Orbit (HEO). Orbital mechanics is not a trivial subject, but let's explore some of the interesting basics and what is involved in reaching these orbits.

Some Basic Launch and Orbital Physics

Let's begin by defining an orbit and the physics that affect the launch and final orbit.

We all know that gravity causes objects to be attracted to the center of the earth. The same is true of objects in space around the earth, but this effect decreases the further the object is from the earth's center.

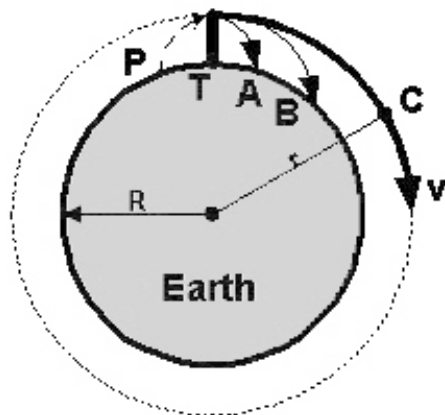


Figure 1: Basic launch diagram.

Using Figure 1, visualize a projectile launched at different velocities horizontally from the top of a very tall tower T, above the earth's atmosphere.

- Launched with a low initial velocity (less than 3000 m/sec), it would fall to earth a short distance away, following a parabolic path.
- Launched with a medium velocity (5500 m/sec) it also falls to earth, but at a greater distance from the tower.
- Launched with a high velocity around 7700 m/sec, it also will fall to earth, but it follows a curved path, keeping its distance from the earth's center constant.

Now let's launch a rocket from the ground vertically at location P. As the rocket speed increases, the guidance system gradually turns the rocket so that at the instant the fuel is exhausted the last stage has the proper height, speed and direction for the selected orbit. The precision required to do this is quite difficult, so all initial orbits are not exactly as predicted. How accurate the launch system has been in hitting the proposed orbit is an important advertising point for most launch organizations. Sea Launch has target diagrams on their site highlighting the accuracy of some of their launches.

http://www.sea-launch.com/past_pas9.html
For a satellite to have a circular orbit around the earth, the satellite must achieve a velocity such that its centripetal acceleration (v^2/r) is equal to the acceleration due to gravity (g_r) or $v^2/r = g_r$. We determine that velocity using the following equation:

$$v = \sqrt{g (R^2/r)}$$

where v is the velocity, g is the acceleration due to gravity at the earth's surface (9.8 m/s^2), R is the earth's radius (6360 km), and r is radius of the satellite orbit. The altitude of the satellite above the earth then determines the necessary velocity of the satellite. The Period is the length of time it takes the satellite to make one revolution.

To place a satellite in circular orbit at 800 km we substitute in the formula above:

$$\begin{aligned} v &= \sqrt{[9.8 * (6,360,000)^2 \text{ m/s}^2 / 7,160,000\text{m}]} \\ &= \sqrt{(55.4 \times 10^6 \text{ m/s}^2)} = \\ \text{satellite velocity @ 800 km orbit} &= \\ 7441 \text{ m/sec} &= 16,644 \text{ mph} \end{aligned}$$

Orbital Altitude	Satellite Velocity (m/sec)	Satellite Velocity (mph)	Period in Minutes
300 km	7,715 m/sec	17,258 mph	90.3
350 km (shuttle, ISS)	7,686 m/sec	17,193 mph	91.3
400 km	7,658 m/sec	17,130 mph	92.4
500 km	7,602 m/sec	17,004 mph	94.4
600 km (UO-11)	7,547 m/sec	16,882 mph	96.5
700 km (OO-38)	7,493 m/sec	16,762 mph	98.6
800 km (AO-27, UO-14)	7,441 m/sec	16,644 mph	100.7
900 km (RS-10/11)	7,389 m/sec	16,529 mph	102.8
1000 km	7,339 m/sec	16,417 mph	104.9
1100 km (FO-29)	7,290 m/sec	16,306 mph	107
1200 km (met-3/5)	7,241 m/sec	16,198 mph	109
1300 km (FO-20)	7,147 m/sec	15,988 mph	111
1,450 km (AO-7)	7,124 m/sec	15,937 mph	114
35,786 km (GSO)	3,068 m/sec	6,862 mph	1,434
391,000 km (moon)	1,000 m/sec	2,237 mph	41,392

Table 1: Representative altitudes, satellites and velocities for circular orbits.

After examining the data in Table 1, your initial impression is probably that the data is incorrect, since the satellite velocity

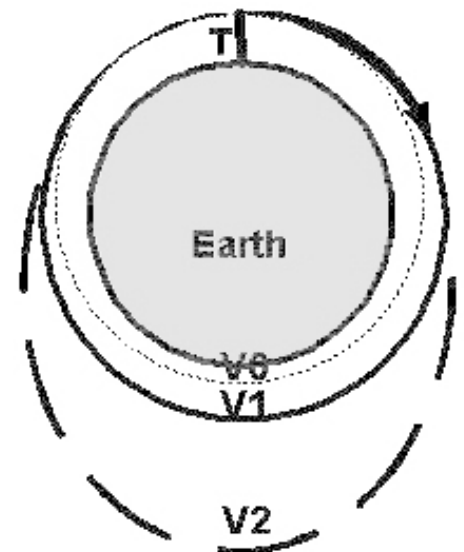


Figure 2: Resultant orbits with velocities close to a circular velocity.

decreases, as you get further away from the earth and its gravity. Intuition might tell you that the speed should increase the further from the earth you go, but actually the opposite is true. To move a satellite into an orbit further from the earth it actually must reduce its velocity to stay there. It is necessary to increase launch velocity to get it there, but once there it must be slowed down. And even more counter intuitive, to get a satellite like the shuttle to return to earth it must speed up, to lower its orbit. The closer a satellite is to the earth the faster it moves in its orbit. Velocity is crucial and determines both the altitude and the type of orbit.

To achieve a circular orbit the satellite must have the correct velocity when it is separated from the launch vehicle. Too fast or too slow will result in an elliptical orbit.

Figure 2 shows the resulting elliptical orbits when the release velocity is close to the circular orbit velocity (V_1). Notice that all three orbits go through the injection point at the top of the tower.

$V_0 = 6807$ m/sec, elliptical orbit with perigee opposite the injection point and too close to the atmosphere causing the perigee to get lower each pass.

$V_1 = 7440$ m/sec, circular orbit, apogee and perigee values very close.

$V_2 = 8047$ m/sec, elliptical orbit with apogee opposite the injection point.

Orbits

The orbital plane of a satellite runs through

the center of gravity of the earth. Since the earth rotates under the satellite the orbit actually changes constantly since the earth is not round and consistent. For example, the recent December 2004 earthquake that caused the tsunami actually changed the shape of the earth and the orbits of all satellites. This was only a slight change, but these changes are a cumulative thing. Inclination is an important element in defining an orbit. It is the angle measured as the satellite goes from south to north, called the ascending node, between the orbital and equatorial planes. See Figure 3. Note the inclination angle measurement i at the equator and the satellite direction. Inclination is also defined as, the angle between H , the angular momentum vector, and the earth's rotation vector.

If the inclination of the satellite orbit is less than 90° it is called a Prograde orbit ($0^\circ \leq i < 90^\circ$). The orbit is Retrograde if the satellite movement is against the rotation of the earth ($90^\circ \leq i < 180^\circ$). For a Geostationary orbit the inclination has to be exactly 0° . A Polar orbit is one that is perpendicular to the equator with ($i = 90^\circ$).

Types of Orbits

There are a number of ways to categorize orbits; generally this is done by shape and altitude. The shapes are circular (with low eccentricity) and elliptical with higher eccentricity – oval-shaped. Often the circular orbits are relatively close to the earth, while the elliptical orbits are farther. See Table 2 for a better comparison.

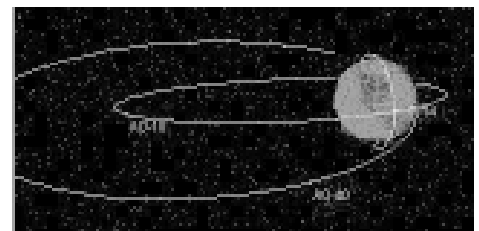


Figure 4: Elliptical Orbit.

A **polar orbit** is the simplest orbit type. The orbit is circular and inclined 90° (or close to 90°) to the equator with the satellite passing over each of the poles during each orbit. This orbit allows all points on earth to be in view of the satellite twice each day. Typical polar orbits are at an altitude of 850 km with a period of 100 minutes. There are just over 14 orbits per day. At this altitude the satellite has a ground view of an area about 3000 miles wide.

Sun-synchronous is a special case circular, polar orbit. It has an inclination of 98.7° , a retrograde orbit. This precession of the orbit matches the apparent motion of the sun relative to the earth, about 1° per day. The key feature of this orbit is that in each half of the orbit, the satellite always crosses a particular line of latitude at the same local solar time each day. The angle of the sunlight will therefore be consistent, only varying slowly as the seasons change in the course of a year. These orbits are commonly used for satellite imaging.

Geosynchronous orbits allow a satellite to appear stationary from the point of view of an observer on earth. The orbital period matches the rotation rate of the earth. The rotational rate is the sidereal day (23h 56m 4s), not the twenty-four hour civil day.

Often geosynchronous and geostationary are used interchangeably, but they are not the same. The definition of geosynchronous does not specify the shape or orientation of the orbit. So, geostationary is a special case of a geosynchronous orbit, it has added stipulations that the orbit is circular and it lies in the equatorial plane. To save energy by not having to correct their location as often, most geosynchronous satellites oscillate in a figure 8 pattern. The shape of the receive antennas for GSO satellites are designed to cover this movement. Actually most satellites considered geostationary are actually geosynchronous, because their orbits are slightly elliptical and not quite on the equatorial plane, thus extending their lifetime.

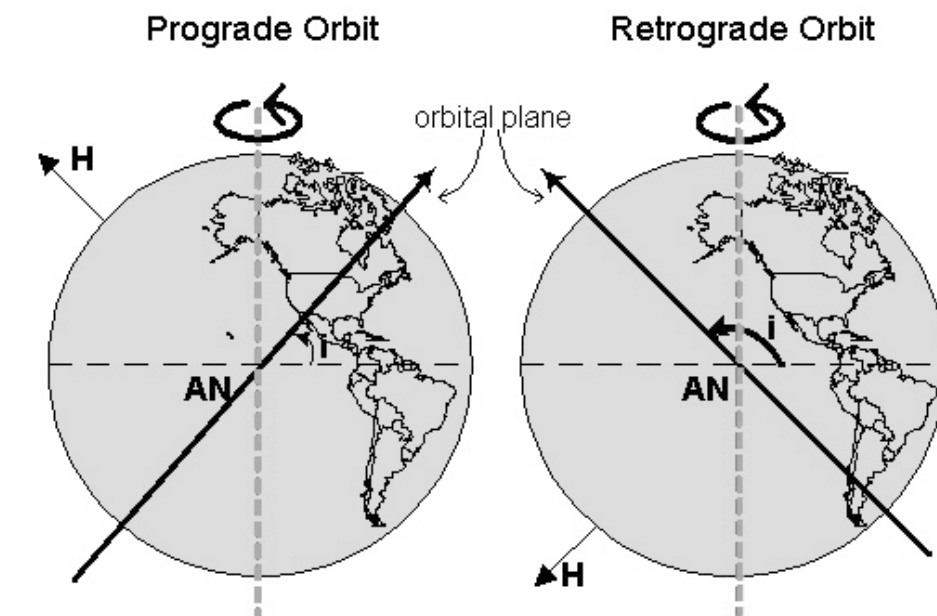


Figure 3: Orbits diagram.



An **n-th resonant orbit** is one that completes an integral number of orbits in one day.

A 15th order resonant orbit will complete 15 orbits in a 24-hour day. The shuttle often uses a 16th order resonant orbit because it permits same day synchronization with work and sleep schedules.

Molniya orbits are highly elliptical orbits with inclinations of 63.4° or 116.6° and perigee values from 200 – 1000 km. These orbits allow views of the northern hemisphere for 11 hours out of 12 for either the US or Russia. If the perigee is in the southern hemisphere, it stays there and does not move into the northern hemisphere as other orbits. This orbit was created to provide communications between Washington, DC and Moscow during the Cold War.

GSO – Geostationary Earth Orbit (Direct Broadcast, Fixed Satellite, Intersatellite links)

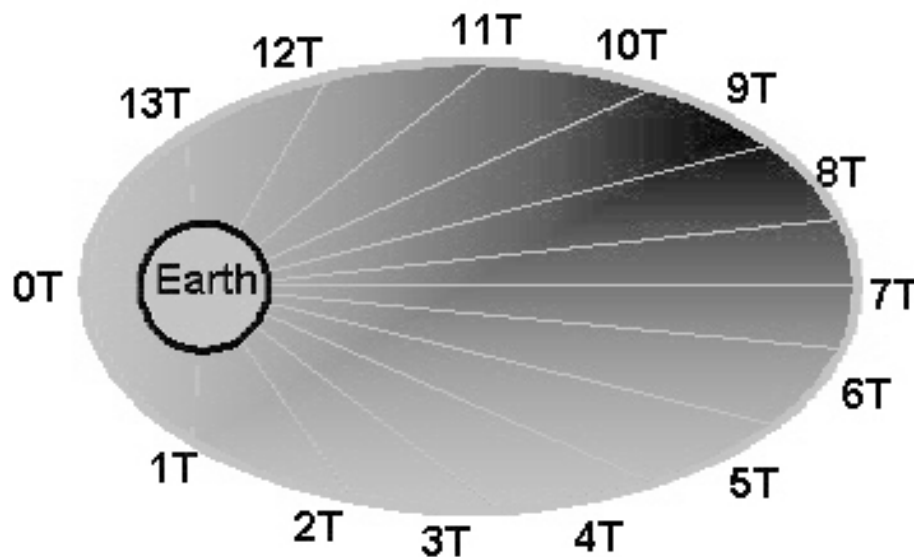


Figure 5: Equal areas in equal time periods.

Non-GSO { LEO – Low Earth Orbit (voice, high speed data, rescue, remote sensing)
MEO – Medium Earth Orbit (voice, data, radionavigation, reconnaissance)
HEO – Highly Elliptical Orbit (communications services)

have a ‘slow’ satellite to track and the largest footprint (half the earth). Kepler explained this phenomenon with his Second Law, the area of the orbital plane is equal for equal time periods. So, out around apogee there are very small azimuth/elevation changes needed because the distance keeps the east/west arc small. Using an hour as a reference time, at apogee a satellite like AO-40 only moves 10° in Azimuth and 10° in Elevation. Conversely, for an hour around perigee the satellite must cover quite a distance during this time so that the area of this arc will equal the area of the arc at apogee. Again, looking at AO-40 for an hour around perigee the azimuth will change about 180° and an elevation change of 60°.

Changing Orbits

Almost all satellites start off in elliptical orbits because it is so difficult to get the exact release speed needed for a circular orbit. Most satellites fire rockets when they are above the earth’s atmosphere to correct the orbit. To change an orbit a satellite must actually be in an elliptical orbit. An in-orbit burn is generally necessary and may be done by the upper stage of the rocket if it is re-startable. After the current orbit is determined, then the correction is calculated and the burn commences. A horizontal burn will increase or decrease the velocity of the satellite, making the orbit more elliptical or circular depending upon: 1.) Where in the orbit the burn takes place; 2.) How long it takes place and in which direction the burn occurs.

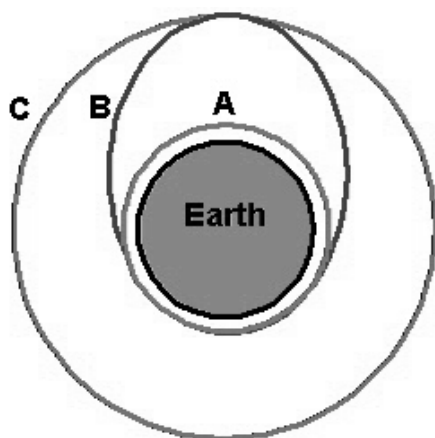


Figure 6: Hohmann Transfer Orbit.

Elliptical orbits like AO-10 and AO-40 constantly change their distance and velocity during the orbit. The fastest speed is at the closest point in the orbit, perigee and slowest speed at the furthest point, apogee. This is much like being in a swing, as you approach the most distant point from the earth you slow down, until you reach the maximum height. Then you begin picking up speed until you reach the maximum speed at the bottom of the arc, when you start slowing down again.

The reason so many AMSAT members enjoy HEO operation is that during about two thirds of the elliptical orbit the operators

	Altitude, km	Eccentricity	Inclination	Period	Mean Velocity
LEO	500 - 1000	Low	30 - 90 degrees	1 - 2 hr	~ 7.3 km/s
MEO	5,000 - 10,000	Low	30 - 90 degrees	5 - 8 hr	~ 5 km/s
GSO	35,786	0	0 degrees	23h 56m	~ 3 km/s
HEO:					
Ellipso	520 - 7846	~ .35	116.4 degrees	3 hours	~ 6.5 km/s
Archimedes	1000 - 26,800	0.63	63 degrees	7h 59m	~ 5 km/s
Molniya	500 - 39,400	0.74	63.4 degrees	11h 58m	~ 4 km/s
Tundra	25,250 - 46,300	~ .25	63 degrees	23h 56m	~ 3 km/s

Table 2: Typical orbit parameters for general satellite classes.

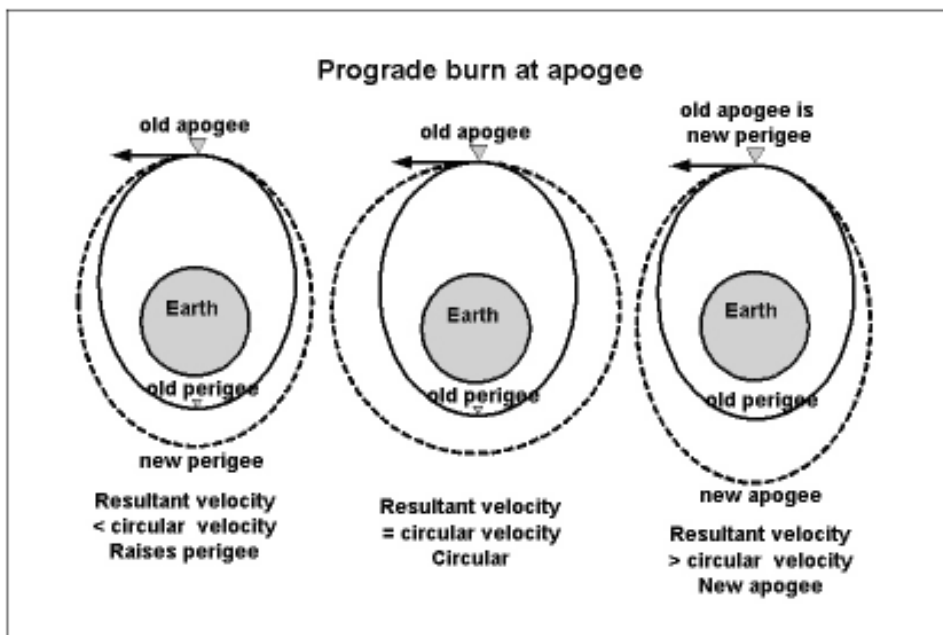


Figure 7: Apogee burn diagrams.

Hohmann Transfer Orbit

This ability to change orbits is very important to getting a satellite into its prescribed orbit, but doesn't come cheap – a great deal of energy is needed. The most efficient method to change from a circular orbit to another circular orbit in the same plane is known as the Hohmann Transfer. The reason it is fuel-efficient is that the second burn only has to slow the craft down to the correct velocity for a circular orbit at that altitude.

A **Posigrade** burn is one done in the opposite direction the satellite is moving, used to increase its velocity. If done at perigee in a circular orbit, the orbit will change to elliptical with an apogee further away. Looking at Figure 7 this would change the

orbit from A (circular LEO) to B (elliptical), it has the same perigee, but new apogee that is at a greater altitude. The new orbit will always intersect the old orbit at the burn point.

Starting with elliptical orbit B and doing a retrograde burn at apogee will keep the same apogee, but will result in a new perigee at a greater altitude and close to a circular orbit if the correct velocity is attained.

Remember that you have to decrease the velocity once in a higher orbit. After the burn, the resulting velocity of the satellite determines whether the orbit is circular or elliptical.

When the Posigrade burn takes place at perigee the apogee changes, and the perigee stays the same. If the burn takes place at

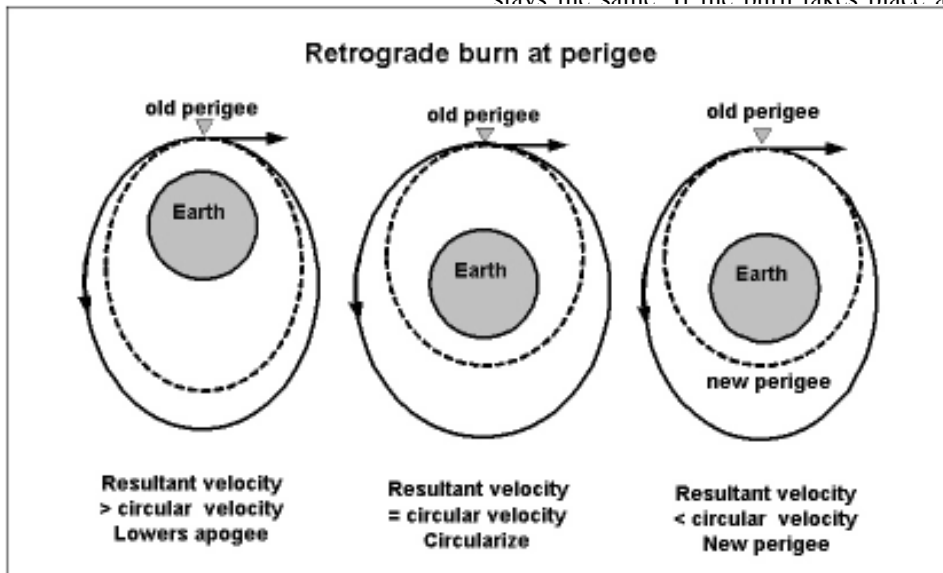


Figure 8: Retrograde burn diagrams.

apogee the perigee changes and the apogee stays the same, with the orbit becoming more circular (decreasing eccentricity), assuming that the correct velocity results.

Retrograde burns are in the same direction as the satellite is traveling, like reversing the direction of the engines exhaust during a jet landing and will slow the spacecraft down. Using the diagrams in Figure 5 and doing the retrograde burn at perigee will lower the velocity causing one of three results depending upon the amount of velocity change, delta V. If the velocity is greater than needed for a circular orbit the apogee will decrease. If equal to the circular orbit velocity, then the orbit will indeed become circular. And if the velocity is less than that need for a circular orbit the perigee will decrease to a point closer to the earth.

The Space Shuttle can deliver a satellite into an orbit with an inclination of 28.5° and an altitude of 300 km. If the satellite is destined for geosynchronous orbit then the satellite must move to an inclination of 0° and an altitude of 35,786 km. This will involve both an inclination change and an altitude change. The Hohmann Transfer is used to change the altitude, but a plane change is a different matter. It requires a great deal of energy for a spacecraft to change planes. More energy needed, means a larger launch vehicle, more cost, less payload mass – always tradeoffs. Since the point in an orbit when a burn occurs becomes part of the new orbit, it is necessary to make this plane change when the current orbit crosses the 0° plane. These two planes only intersect at two points during the orbit. Since we have already achieved the correct altitude the only action will be to plan the necessary vector direction to move the spacecraft from 28.5° inclination to 0° . This requires a burn at an angle of -75.7° and a change in velocity from 7.726 km/sec to 3.801 km/sec. Normally the plane change is accomplished in two steps. About 2° of the plane change occurs during the first burn from circular to elliptical (A to B). Then 26° of the plane change occur during the second burn - elliptical to circular.

Orbit Selection

There are a number of companies that specialize in computing the best orbit for a particular project or mission. The University of Edinburgh Web site has a JAVA Orbit Simulator. If you are interested in experimenting with what the final orbit of a satellite would be by changing certain launch parameters, check out the simulator site. This



Possible Launch Angles



Figure 9: Possible launch angles from selected launch sites.

can be found at: <http://www.met.ed.ac.uk/courses/projects/gavin/Satellites.html>

Some of the factors to determine the type of orbit are:

- Payload Mass
- Capability and objective of the sensors
- Mission lifetime
- Necessary altitude to perform the functions
- Sun-synchronous orbit or not
- Orbital precession
- Stationary position or constantly changing position
- Launch reliability
- Launch cost
- The launch site and its relationship to a satellite's inclination

The most efficient way to launch a payload into orbit is to launch it due east. This will take maximum advantage of the earth's rotational speed at the surface. But to launch directly into an orbit it is necessary to wait until the launch base crosses the intended orbital plane, hence the launch window. At the equator this velocity is 1,037 mph, at Cape Canaveral the speed has already been reduced to 915 mph and is 0 mph at the poles. Launches in any direction other than east necessitate the expenditure of extra fuel. It is easy to see why Kourou and Sea Launch both offer advantages; this boost from the earth's rotation can be used to carry more mass into orbit. This is the same advantage you get when throwing a ball when running forward, like in cricket or a javelin.

If a rocket is launched due east, with no directional changes, it will result in an orbit

with an inclination equal to the latitude of the launch site.

Cape Canaveral is at 28.5° N latitude, so a launch due east will result in a satellite orbit with an inclination of 28.5°, which is a common orbit for the Space Shuttle. The down side to a 28.5° inclination orbit is that areas above latitude 48° cannot see the satellite.

Launch sites can physically launch directly into any orbital inclination that satisfies this relationship: $|f| \leq i \leq 180^\circ - |f|$, where f is the latitude of the launch site. Many of the launch sites are further restricted in their actual launch angles because of safety concerns that the burned out rocket stages might fall on populated areas. As such, the minimum launch angle from Cape Canaveral is 35° and the maximum is 120°. China had problems with many of its early launches from Xichang because parts of the rocket fell on populated areas. A launch in 1998 from Vandenberg was held up for weeks, because the standard United Nations population census had become out of date and a small island in the Pacific had become inhabited and was in the flight path. The flight path was altered.

The formula to compute the orbital inclination based upon the launch location and launch angle is:

$$\cos(\text{inclination}) = \cos(\text{latitude}) * \sin(\text{launch azimuth})$$

The orbital velocity of an object directly determines the altitude and shape of the orbit. Achieving this velocity is quite difficult because a great deal of energy is necessary

to develop this velocity for the satellite. A great deal of energy means a great deal of mass for the fuel, rocket and payload that must also achieve this speed.

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The Portuguese Student's Approach to Space Flight Educational Satellite Simulation Program using Meteorological Balloons

by Mariano Gonçalves, CT1XI. Translation assistance by Emily Clarke, W0EEC.



The CinelSAT Project Summary

If we wanted to make a short description of this project it would be something like: "Satellite simulation without rockets, using meteorological balloons for environmental and technological educational applications, including physical, aeronautical and electronic integration systems, radio communications and tele-detection on sea and atmosphere, providing scientific experiences for young engineers to prepare for an aerospace career". Quite a long description, but one that characterizes the CinelSAT Project quite well.

CinelSAT Background

This project was created by Mariano Gonçalves, CT1XI, in 1995 as SimSAT among radio amateur enthusiasts in Portugal.

The goal of this project was to make scientific experiments in a national environmental, non-profit association - Liga Ambiental para a Educação Juvenil e Ciências do Mar (Sea League). In 2000 the project was transferred to Aerospace Observatory of AMRAD (The Radioamateur Association for Education, Research and Development (www.amrad.pt), an AMSAT partner. The SimSAT educational satellite simulation program was supported 25% by the Portuguese Government Science and Technology ministry in 2001. The Portuguese government, due to the fault of money is paid only half of the total of SimSAT project costs, was estimated at less than USD: 25,000.

Since 2001 AMRAD members pay all the costs of the educational satellite program. There have been more than 3,500 school students participating, including introducing the program to visitors of the Oeiras Aerospace Observatory of AMRAD, a science museum located near Lisbon, created with the help of local council authorities. In conclusion "football was the main goal of the Portuguese development policy" or so it was thought, but in fact in 2003 a protocol was signed between AMRAD and CINEL (Centro de Formação Profissional da

Industria Electrónica da Região de Lisboa.) The CINEL director's enthusiasm surpassed all expectations and obstacles to start this new program, which would achieve a great success and much higher goals.

The project development was scheduled for three phases, distributed over three years: CinelSAT I (2003), CinelSAT II (2004) and CinelSAT III (next April 2005).

The goal of the CinelSAT program is to motivate students to develop electronic modules and perform system integration, starting with simple technology up to more complex steps, gathering knowledge in space technology, radio communications, electronics and mechanics. The students participate actively in the development and assembling of electronic modules, improving skills in practical electronics, radio communications, mechanics and even doing some hands-on work with "launching facilities" logistics and government paperwork. Completing these tasks improved the trainee's skills in producing electronic modules, focused electronic class behaviour and helped the students overcome several technical problems such as payload weight, atmospheric conditions during CinelSAT 2 launch, deadlines and bureaucracy.

Even though there were difficulties and obstacles to overcome, trainers and students surpassed expectations and their will to continue with CinelSAT Phases 3, 4, 5, is higher than anyone had imagined!

CinelSAT I - Endiel Exhibition (May 2003)

The CinelSAT I phase was only intended for students to have the first contact with the technology involved onboard a satellite and electronic modules integration such as small radio systems, telemetry and control simulation. It was based on a VHF-UHF FM Cross-Band Repeater and integrating these systems the main goal. Students would also contribute to making the system fly to the high atmosphere by filling latex balloons with helium and suspending the satellite payload and parachute.





Until this time, the students worked on the phase I integration under the supervision of trainers and AMRAD (AMSAT-CT) personnel. Tasks consisted of testing and measuring several UHF transmitters and VHF receiver and transmitter parameters of the cross-band FM repeater such as oscillators, minimum voltage, PLL and power amplifiers. They also measured the standby and transmitting power consumption and the battery discharge time so they could calculate how long the energy system would last. As system weight was also very important, students weighed all system components like the transmitter, receiver, battery, antennas, connectors, cables, mechanical parts and others.

In the following phase mentors would help the students to work on the control module including timers and switchers that would permit the fundamental system low power consumption.

Here are some photos of the Endiel



exhibition, were we can see the 1.8m balloon with a demonstration payload suspended in the air and at the table the real payload which would be on-board.

CinelSAT II - Serpro Exhibition (October 2003)

Six months passed since the CinelSAT I project and the students had already worked hard on

CinelSAT II, which would now include a higher cost and more advanced payload, including a video camera, an ATV (amateur television) transmitter at 1260MHz, a GPS receiver and an APRS tracking device sending information through a VHF transmitter on 145.850MHz. This system would now be able to transmit its position to ground stations and be tracked by an APRS (Automatic Positioning Reporting System) software as well as sending video images captured by its on-board camera during flight. This data was broadcast into the Internet and the APRS Worldwide Network on 144.800MHz.

The payload of CinelSAT II weighed 1.8 Kg, which required us to use four balloons to guarantee the correct lift. The parachute was adjusted for the payload weight, which resulted in a chute with a 2.2 m diameter. The commitment by students, instructors and AMRAD personnel to reach this higher goal made it possible to have this new balloon ready to fly in early October 2003.

A project like this involves lots of people, logistics and coordination with several entities and government institutions such as National Aviation, Portuguese Air Force, Space Navigation and the Meteorological

Institute which required us to acquire many authorizations. After overcoming some last minute bureaucracy problems with the National Aviation authorization request to launch the balloon, as well as three additional days of logistic issues it was all set for the big event and all teams were ready and standing by at the Coimbra's City Hall Stadium waiting for the results of months of research and development. Finally the phone call arrived and the CinelSAT II project was flying at 17:30 UTC of the 24th October 2003.

Not even an intense rain and generally bad weather during the day could stop everything from running as scheduled nor weaken the CINEL and AMRAD team's spirit. After being launched by a ceremonial cutting of the tether by the CINEL director, CinelSAT II began ascending to the high atmosphere



heading west under the eyes and expectation of all the people involved in the project, along with lots of media representatives who recorded every minute of this happening.

From this moment on our goal would tracking and data collection during the next two or three hours, until the balloon reached about 30 km high where after expanding to its limit it would explode. Then it would start descending using its parachute and be recovered. Unfortunately the storm didn't let it reach such an altitude where the balloons expansion was sufficient to explode and so CinelSAT II remained floating around 7 km high for about 15 hours! The balloon flight continued in a westerly direction until around 20:27 UTC when it was about 150 km from Aveiro's western coast of the Atlantic Ocean, when the wind took it toward the north.

The on-board video transmission worked just fine, though we didn't have much video time as the flight started later than scheduled



nearer to nightfall. Because of the storm several low altitude clouds obscured the view making it difficult to get ground images. The main problem we found was that we weren't receiving any positioning data. This was never detected during the testing period and after some reflection we concluded around 20:30 UTC that the ATV video transmitter must be interfering with GPS reception. Our solution was to estimate the balloon position until 22:15 UTC and as the ATV transmitter batteries became weaker the GPS began receiving data, sending us the correct positioning and confirming everything was right with the balloon systems.

This information was received with glee by all teams involved including several Amateur Radio enthusiasts who cooperated with their well equipped mobile and base



stations helping us to gather positioning and video data. The first packets received by all the stations indicated that the balloon was about 150 km at an altitude of 5200 meters (16,900 feet) off Aveiro's west coast on the Atlantic Ocean.

We had estimated at least nine hour power life for the APRS positioning circuitry which was exceeded

since the balloon was heard until the next day at 8:50 UTC by Spanish Amateur Radio stations in the Vigo and Santiago de Compostela areas.

CinelSAT II made a long 15h 20m voyage, travelling about 700 km and reaching a maximum altitude of 27,150 feet oscillating between 3 and 9 km high. Last satellite data collected by Spanish radio amateurs showed us its presence at 1650 Km northwest of Santiago de Compostela and as batteries went dead before its fall. We estimate it perhaps floated over the Atlantic Ocean several more hours.

CinelSAT's great success will be forever recorded in the memories of those who were directly or indirectly involved on this project and it will certainly continue with many future experiments.

Time of Flight World Record

North American radio amateur Ralph Wallio, W0RPK, a balloons enthusiast, recorded several balloon flight results from worldwide associations since 1992, and also recorded the results of the CinelSAT II flight.

Though there are several flight records, CinelSAT II entered directly into the first place becoming the world's record holder with the flight time of 15h 20m! When this result was published there were many comments from other balloonist groups such as the Grosse Pointe Academy, in Michigan, which wrote the following comment as soon as they received this news:

"The SimSat balloon in Portugal beat us out of number one, but we'll take this back in the summer."

The complete article can be read on the ARRL Web site at: <http://www.arrl.org/news/stories/2004/03/03/103/?nc=1>

As we all know CinelSAT II overcame serious bad weather conditions that somehow became an advantage to achieve this long lasting flight time. We still don't know how much longer it stayed aloft since we lost contact before the balloon reached ground level over the ocean. The last data collected shows it was still travelling 6 km high when the batteries went dead.

The next CinelSAT balloon flights will likely not surpass the flight time world record of CinelSAT II, though other records as altitude, weight, ascending and descending velocities, and maximum communications distance with ground station are not only possible but are a goal.

CinelSAT III - SerPro Exhibition (April 2005)

This next phase of the CinelSAT project promises to be the greatest ever made in Portugal with even higher goals. We anticipate special media coverage, greater government support, and more enthusiasm from the amateur community. The payload



will have 3 cameras on-board, a ATV transmitter, VHF-UHF FM Cross-Band Voice Repeater, 40m CW Beacon, APRS and additional control circuitry. The project weight is about 3 kg suspended with several balloons. It will be once again launched at the SerPro exhibition. We recommend everyone stay informed as we will broadcast this launching on the Internet. We are proud that the CINEL and AMRAD's teams, mentors and students are working with the same commitment and effort to achieve even greater goals.

More information can be found at www.amrad.pt or by request to the board of directors at info@amrad.pt.



AMSAT P3E Meeting Report

by Rick Hambly, W2GPS and Bob McGwier, N4HY

A P3E satellite design review meeting was held in Marburg Germany from January 26th through January 30th. The primary focus of this meeting was the design of the IHU-3 and the CAN-Do! Interface modules. In attendance for AMSAT-NA were Dr. Bob McGwier, N4HY, Bdale Garbee, KB0G, Stephen Moraco, KC0FTQ, Lyle Johnson, KK7P and Chuck Green, N0ADI. AMSAT-DL was represented by AMSAT-DL President Peter Guelzow, DB2OS, Prof. Dr. Karl Meinzer, DJ4ZC, Hartmut Paesler, DL1YDD, Gerhart Metz, DG2CV and P3E Project Manager Heike Straube. A great deal of progress was made during the week. A detailed task and schedule list was prepared for completion of IHU-3 and related tasks over the next several months.

AMSAT-NA President Rick Hambly, W2GPS, who spent the week in Germany and Austria on business, joined the meeting on Saturday, January 29th. This was Rick's first visit to AMSAT-DL in Marburg. Rick was very pleased with the warm reception he received and with the great progress that has been made on the P3E satellite.

The IHU-3 prototype was presented to the P3E computer team by Lyle Johnson and Chuck Green. Based on the ARM7 processor, the computer will allow us to leave the Cosmac 1802-based integrated housekeeping unit (IHU) for good.

The IHU will have an increased role in the P3E satellite and in follow-on spacecraft. It will also run as a software defined radio to act as the last IF in the command receiver. The goal is to be able to run a very high quality forward error correction that will even enable the command link to operate on the P5 spacecraft that AMSAT-DL wishes to build and fly to Mars orbit.

Bdale Garbee and Steve Moraco talked about the new C A N - D o ! spacecraft bus based on technology tested in the AO-40 spacecraft.

Bob McGwier agreed to be part of the software development team and to build the low level tasks (interrupt handlers, various IO and watchdog tasks) that will allow the spacecraft command system to be booted.

The IHU code will be based again on IPS. Various P3E team members are experts in IPS and the team will make a Linux version

of IPS-32. Bob and Bdale agreed to implement the low level tasks and the device interfaces to enable IPS to run under Linux with access to the file system, graphics, and other devices.



AMSAT-DL President Peter Guelzow, DB2OS; AMSAT-NA President Rick Hambly, W2GPS; Prof. Dr. Karl Meinzer, DJ4ZC; and new AMSAT-DL VP and Bochum antenna project manager Hartmut Paesler, DL1YDD examine the P3E spacecraft frame in Marburg Germany, January 29, 2005.

Karl reported that he had nearly completed the high level IPS and that a basic compiler was the last major step in the IPS development.

An ambitious schedule for development of the flight computer and software were set for completion by Fall '05. 🌐



P3E designers at work. Counterclockwise around the table are Prof. Dr. Karl Meinzer, DJ4ZC; Hartmut Paesler, DL1YDD; Chuck Green, N0ADI; Bob McGwier, N4HY; Gerhart Metz, DG2CV; Lyle Johnson, KK7P; Bdale Garbee, KB0G; and Stephen Moraco, KC0FTQ.

The
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Journal





First Argentinean Satellite - 15-Year Celebration of First Orbit

1990 - January 21st - 2005

On January 21st, Argentina commemorated an important anniversary. Argentina is marking the 15-year anniversary of putting their first satellite into orbit. This event was not marked by official ceremonies and it didn't give rise to significant demonstrations on the part of the public powers. Lusat-1 turned out to be a small object in the middle of other greater ones that were sent to space on an Ariane rocket, of the European Space Agency.

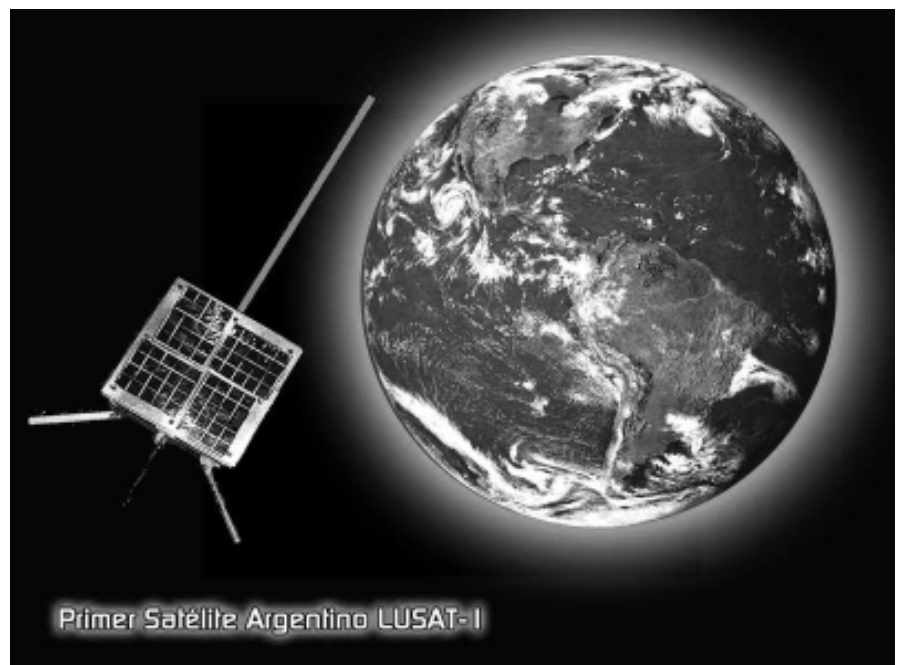
This satellite didn't have commercial aims or profit goals. It was made by radio hams and it was meant to add Argentina to the 6 countries with satellites in space at the time. Its mission was to provide communications in digital systems to all the radio hams in the country and the world. Although the batteries operate at a fraction of their initial power, Lusat-1 continues to work. This private initiative has had been accomplished in this small prodigy of engineering and electronics, completed with limited resources, although with enthusiasm and talent.

The people that worked so hard on this satellite deserve to be recognized, especially with the success and the effectiveness of Lusat-1, which was accomplished with limited resources of the country at the time. Now, after so much time, a new project is on the horizon. This project will also be completed by the praiseworthy activity of radio hams.

Osvaldo Gago, LU9EOH, President

Daniel Cenci, LU4DC, Secretary

E-mail: Indarsat@lusat.com.ar



AMSAT Active at AM-Tech Day

by Emily Clarke, W0EEC, w0eec@amsat.org

In November 2004 the Foothill Amateur Radio Society (FARS) began a monthly event called "AM-Tech Day" to encourage amateurs to gather and share their ham radio experiences. Hams are encouraged to bring their equipment, set up station and demonstrate their equipment, antennas and skills to other hams! It is not unusual to see dozens of different antenna designs (mostly HF) and rigs of all types.

In January it found a permanent home at the Stanford Linear Accelerator Center in Menlo Park and Emily Clarke, W0EEC, AMSAT Area Coordinator on the SF Peninsula informally attended and gave some satellite demonstrations on FM sats using an Arrow and handheld radio. There was enough interest that she was invited back to give a presentation and set up a booth in February.

On February 5, 2005 (which was the rescheduled Kid's Day on AO-51), Emily demonstrated her "condo-portable" antenna system including her Icom 910 with full Doppler tuning provided by her MacIntosh iBook using MacDoppler Pro. She brought along her "condo portable" antennas - fixed elevation Yagis mounted on a collapsible

mast, which she uses at home in her CC&R'd condo complex.

In the morning, she and visitors operated on five satellite passes over AO-7, FO-29, AO-51 including contacts with kids in California and Alaska. After her presentation on "Beginning Amateur Satellite Operations" the event continued to work passes on SO-50, AO-27 and FO-29 before darkness set in. Overall the event worked over 25 states and provinces from New Jersey to Ontario, Texas to Alberta and Alaska.

In addition to demonstrations, several visitors made their first satellite contacts including Carol, W6GEM, (below) and Pink, KG6ILA. Carol made contacts with VE6AB and VE6EGN in Alberta Canada in a very short time. "This is just fantastic!" said Carol afterwards. "I'm not a 'techie', but this has really caught my attention!"

In addition to live satellite demonstrations and Emily's presentation, those interested in satellites were also invited to attend the monthly meeting of Project OSCAR, where they were introduced to Project OSCAR's history, it's current mission and plans for the West Coast Space Symposium to be held in

May. Project OSCAR President Don Ferguson was on hand to welcome the group and invite those interested to inquire about membership.

On March 5th 2005 AM-Tech day will be held once again. The satellite topic for the day will be Amateur Satellite Packet and with demonstrations of the Echo BBS, Echo Telemetry and ISS APRS using only a TH-D7A handheld for the transceiver interfacing with MacEchoTlm, MacTNC, iDXCluster and Xastir.

If you live in the San Francisco Bay Area please visit AM-Tech day and consider participating! AM-Tech Day will be held every month on the first Saturday at the Stanford Linear Accelerator Center on San Hill Road in Menlo Park. Please be advised that a photo ID is required to enter the site. If you plan on demonstrating any antennas and equipment be aware that RF and electrical safety policies are strictly enforced.

For additional information contact Emily at W0EEC@amsat.org or visit the Foothill Amateur Radio Society website at <http://www.fars.k6ya.org>. 



W0EEC "Condo Portable".
Photo courtesy Mark Lunge, KB6JPA.



Carol, W6GEM, QSOs with Jerry, VE6AB, over SO-50. Photo courtesy Bruce McCaskie, N6THN.

PROCEEDINGS OF THE AMSAT-NA
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by Richard M. Hambly, W2GPS
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by Bob McGuier, N4HY, Gerald Youngblood, AC5OG and Eric Wachsmann
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Our member Mal, NP2L, while shopping one day, spotted this license plate in his rear view mirror. Do you suppose this is some kind of secret code?



AMSAT-UK Space Colloquium 2005

AMSAT-UK will be holding a Space Colloquium at the University of Surrey in Guildford, England from 29 – 31st July.

This 3-day event always attracts radio amateurs from across Europe as well as North America, Africa, Asia and the Pacific. Over a third of those attending come from outside the UK. It provides an opportunity to rub shoulders with the designers of the amateur satellites and find out the latest news.

As in previous years there will be special beginner's sessions to teach newcomers how to get started in the fascinating world of Amateur Radio space communications. You can get started using little more than a standard dual-band FM HT.

An antenna testing range will be available to enable you to check out the gain of your latest antenna, not all commercial antennas perform as well as you might think! Microwave experts will be on-hand with test equipment covering up to 24 GHz so you can have your equipment tested and receive professional advice.

There will be guided tours of the Surrey Space Centre with the satellite mission control centre and the satellite assembly facility. These tours are always popular as they provide a unique opportunity to see satellites in various stages of construction.

The RSGB GB4FUN van, which has a fully equipped satellite station, will be available during the event for visitors to work the Satellites.

Throughout the event there is an extensive lecture programme ranging from highly professional technical presentations to basic down to earth "how to do it" type talks.

Guildford is 40 miles from Central London and easily reached from both London-Heathrow and London-Gatwick airports.

Details of 2 or 3 day packages covering meals and accommodation in the University grounds are available from the secretary Jim Heck, G3WGM.

Tel: +44 1258 453959

E-mail: g3wgm@amsat.org

Website: <http://www.uk.amsat.org/> 



Some of the 2004 Space Colloquium attendees.

Trevor, M5AKA, and Professor Pillinger at the 2004 AMSAT-UK Colloquium.

New Echo Book

AO-51

Development, Operation and Specifications



G. Gould Smith
WA4SXM

A new AO-51 book by Gould Smith, WA4SXM, is now available from the AMSAT office at a cost of \$20. The price to foreign addresses will be slightly higher. This book replaces the original Echo book. It is in color, has 32 new pages (73 total), contains much more information, examples and pictures about AO-51 Operation and Deployment. It also has additional information and photos of the experiments and hardware. Order from Martha at AMSAT Headquarters. 



P3E Update

Frank Sperber, DL6DBN

The previous three months were nearly completely consumed by the preparations for the 30-year celebration of AMSAT-DL. As a result there was no major progress made. There was, however, some work done on the details.

30 Year Celebration Used for Discussions

Several of the transponder builders met at the occasion of the 30 year AMSAT-DL celebration in Bochum to present the intermediate developments and to discuss further details of the mechanical interfaces. Mirek Kasal brought his modules for the L-band and the command receiver. They are waiting for the final programming of the uplink frequencies and the integration into the complete module housing for construction in the satellite. The L-band module then becomes the second integration ready module after the main battery. The work on the transmitters for 24 and 47 GHz as well as the C-band receiver is close to being flight ready.

Michael Fletcher was able to demonstrate his prototype of the X-band transistor output stage in Bochum. They will be a permanent part of the P5A test transponder that can also be switched on as a linear transponder on P3E. Additionally, Michael Fletcher also had a sample construction of the 29 MHz uplink receiver. It is still not clear if the 10-meter band can be integrated on board the P3E. On the one hand there has to be enough available space, and on the other hand the noise level through the switching controls and the oscillators from the satellite cannot be too high. Inclusion of the 29 MHz RX will be decided definitely during the integration work.

The work on the transponder parts for 145, 435, and 2400 MHz has also begun again. William Leijennar presented a more robust design of a U/V transponder. We hope to be able to report in subsequent issues of the *Journal* about further progress on the main transponders.

Preparations on the Cable Assembly

One of the main jobs in the near future is the production of the cable assembly. A P3E 1:1 wooden model was built in Marburg. Originally the model was a rough wooden

frame and was intended for cable layout and measurement. Finally a model evolved, thanks to the competence of Andreas Werner who is a professional cabinetmaker and was present in Marburg; this can later be used for exhibition purposes.

As a result it is presumed that at the beginning of next year the cable assembly can be completed on the model, and can later be integrated into the flight structure.

Problems with the Auxiliary Battery

A secondary or auxiliary battery was again included in the plans for P3E after the difficulties after the battery damage on AO-40. A 4-Ah size battery is being considered. Unfortunately the first cells ordered have proven to be unsuitable. Currently, more suitable cells are being sought in the marketplace. The auxiliary battery on P3E will only be installed if a safe solution to switching between the two batteries can be found, which can't introduce any new failure sources, so that we don't have the switching problems between main and auxiliary batteries that plagued AO-40.

IHU-3 Shows First Signs of Life

The new on-board computer IHU-3, which has already been laid out for the Mars Mission, has successfully completed its early function tests. Program code could be programmed into the various memory areas (flash, EDAC-RAM, unshielded RAM) after the very extensive logic for the Watchdog, control and error correction had been burned into two FPGA's. Additionally, several of the basic I/O functions tested positive. Necessary design changes will be introduced in the next prototypes, which can then be used for the implementation of the IPS.

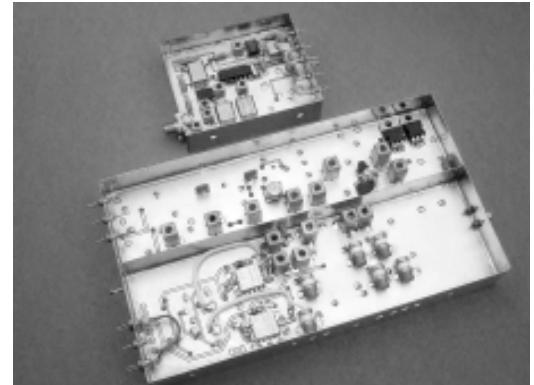
An advantage of the new IHU-3 is its utility for digital signal processing. This then offers better command possibilities for P3E and later radio contact to Mars on P5A. The new IHU with its replaceable implementation could be used for the planned RUDAK system on P3E.

Until now there is no final concrete proposal from a development group so that at least a flight ready hardware package can be assembled based on the IHU-3, the beacon module, and the technology of the command receiver. Still missing is the software for the RUDAK-F communication protocol and the

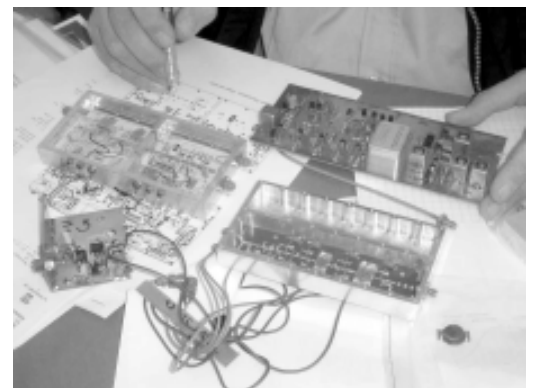
related user services.

Further Working Meetings Planned

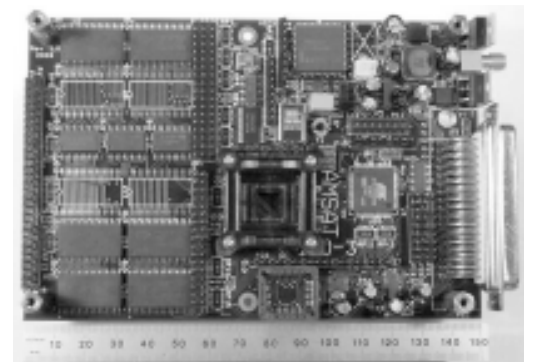
Two working meetings are planned for January and February. At one of the meetings the details for the IHU-3 and the interface to the satellite will be finalized. The second meeting is central to the transponder and should clear up the open matters of the interface and the individual modules and the integration. ☺



The front end and command receiver for P3E's L-band receiver.



The parts of the X-band output stage in the opened housings. At the right rear is the 29 MHz receiver on a sample board.



IHU-3 prototype. Basic functional tests of the new IHU were completed successfully.

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